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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 14 JULY, 1931 NUMBER 1

THE PRESENT STATUS OF PLAUT-VINCENT'S INFECTION *

VOSS HARRELL, M.D.

DETROIT

In 1898, while serving with the French troops in Africa, Vincent [1] reported fourteen cases of a special form of diphtheritic angina due to the fusiform bacillus. No claim was made that the condition had previously been recognized. An American dentist, Willoughby Miller, working in Germany, had described this infectious agent as early as 1883. His observations were comprehensive, including mention of the fact that the micro-organisms would not grow on ordinary culture mediums. The following year a classic description of this condition was published by Plaut, who recognized Miller's work by terming the infectious agent "Miller's organism."

The priority of Plaut's observations and the fact that Vincent merely elaborated them form the basis for the German contention that "Plaut-Vincent's angina" is the proper name for this condition.

ETIOLOGY

The actual inciting cause of Plaut-Vincent's infection is universally accepted as a peculiar form of spirochete associated with a fusiform bacillus. Dietary deficiencies, overindulgence in tobacco and alcohol, trauma to the gums, diseases caused by deficiency in blood and intoxication resulting from mercury and lead constitute contributing factors not to be discounted.

Case reports indicate that persons of all ages are susceptible to the disease, although it is most frequent in the age group from 20 to 40 years. Ill fitting dentures and bridgework that retain particles of food have been fittingly designated as "anaerobic incubators."

Vincent's infection of the gums has been experimentally produced in man by the feeding of small doses of mercury. Jones [2] expressed the belief that Vincent's organisms are common inhabitants of the mucous membranes of the body, becoming pathogenic only under

* Submitted for publication, Jan. 9, 1931.

* Presented as a candidate's thesis to the American Laryngological, Rhinological and Otological Society, 1930.

1. Vincent, H.: Sur une forme particulière d'angine diphthériode (angine à bacilles fusiformes), Bull. et mém. Soc. méd. d. hôp. de Paris **15**:244, 1898.

2. Jones, W. R.: Vincent's Angina Gingivitis Alias Mercurialism, Northwest Med. **27**:291, 1918.

unusual circumstances. By injecting both of the organisms described by Vincent into guinea-pigs, Kritschewski and Sequin,[3] of Paris, were able to produce typical lesions and subsequently recovered both organisms in culture. Neither micro-organism alone was capable of producing the lesions of the disease. Knowledge is not available regarding the frequency of Vincent's organisms in the normal mouth. The literature includes widely varying reports of the relative proportion of healthy carriers in the general population.

The widespread geographic distribution of Vincent's infection is an interesting feature. Cases have been reported from all parts of the world, but they seemingly are more common in temperate and tropical climates than in the Arctic regions.

Actual epidemics of Vincent's infection were reported during the World War, both abroad and locally, as "trench mouth." It is present under endemic conditions throughout the Orient, France and the Americas. The French observers state that their endemic peak is reached every ten years, while in Detroit it is safe to say that the endemic peak is reached every three years. Endemic Vincent's infection in a college population in Texas was attributed by Frazier [4] to kissing, a not uncommon method of direct contact transmission of the disease.

Vincent's infection is not universally included among the reportable diseases. Judging by army reports, the condition is more common in France and Germany than in the United States. This may be attributed in a measure to lesser emphasis on dental hygiene, particularly the failure to use soap dentifrices.

SYMPTOMS

Soreness of the gums or tonsils, foul breath and a putrid taste, associated with a general lack of constitutional disturbance, are the major clinical manifestations of Vincent's infection. Fever is absent or of low grade. Objectively, a grayish-brown membrane on an ulcerated base is readily apparent. There is tenderness on pressure, and the lesion bleeds readily. A moderate degree of hyperemia and edema of the involved structures is regularly present. The lymph nodes of the neck may be enlarged, but tenderness is rarely noted.

The structures affected include the gums, tonsils, pharnyx, nasal cavities, palate, ear-canal, the middle ear, military wounds, wounds in the leg and the genitalia. In one instance invasion of the blood was reported, giving rise to a proved spirillemia. The infectious agent has not been demonstrated outside the human body.

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3. Kritschewski, B., and Sequin, P.: Spirochetosis buccalis: Réproduction expérimentale et traitement, Rev. de stomatol. **11**:613 (Nov.) 1920.

4. Frazier, J. M.: Endemic Vincent's Angina Occurring Among College Students: Report of Sixty-Seven Cases in Ten Days, Texas State J. Med. **93**:166, 1922.

Differential diagnosis from diphtheria rests on the exudate being more localized; the fact that Vincent's membrane is usually unilateral, diphtheria usually being bilateral; the commonly concomitant involvement of the gums in Vincent's infection, and the marked constitutional reaction in diphtheria; finally smears and cultures from the lesions confirm the clinical differentiation. The lesion of primary syphilis has hardened indurated edges about the ulcerated area, and the cervical glands are hard and firm in contrast to the usually soft glands in Vincent's infection. Ludwig's angina is frequently complicated by Vincent's infection and should be mentioned. Noma is usually found on the inside of the cheeks. Vincent's disease must occasionally be differentiated from acute leukemia. The enormous hypertrophy of the gums, together with the characteristic blood picture, is the deciding feature. In some of my cases of leukemia, severe Vincent's infection developed in the gums.

The incubation period of Vincent's infection is not known. Campbell [5] stated that he is sure that it is less than three weeks.

Davis and Pilot [6] showed the invariable association of both the fusiform bacillus and the wide-coiled spirochete. Reasoner and Gill [7] also agreed that the spirochete is motile. There is a difference of opinion regarding the relationship of the two organisms. Tunnicliff [8] advanced the idea that the spirochete is merely a highly differentiated form of the same micro-organism. The best evidence for this view is that by means of a special culture medium the fusiform bacilli regularly formed spirillar forms. Mikell [9] disputed this, while McHenry [10] expressed the opinion that streptococci are involved in some form of the same organism. Vincent's organisms are known to be anaerobic, and grow best in an acid medium. Metabolic products of the organisms in the culture mediums so change the reaction that growth is self-limiting, but not self-exterminating. The fusiform bacillus is the more resistant, and will live but not multiply under aerobic conditions. Ellerman [11] expressed the belief that the short form of the bacterium is a precursor of the spirochete. Tunnicliff proved that the spirochete precedes the fusiform bacilli in

5. Campbell, A. R., and Dyas, A. D.: Vincent's Angina, J. A. M. A. **68**:1516 (June 2) 1917.

6. Davis, D. J., and Pilot, I.: Studies of Fusiform Bacilli and Spirochetes: I and II, J. Infect. Dis. **32**:159 (Feb.) 1923.

7. Reasoner, M. A., and Gill, W. D.: Use of Soap in Prophylaxis of Vincent's Infections, J. A. M. A. **88**:716 (March 5) 1927.

8. Tunnicliff, Ruth: The Microscopic Appearances in Ulcero-Membraneous Tonsillitis, J. Infect. Dis. **25**:132 (Aug.) 1919; Life Cycle of Bacillus Fusiformis, ibid. **33**:147 (Aug.) 1923.

9. Mikell, P. V.: Vincent's Angina, Ann. Otol. Rhin. & Laryng. **35**:528, 1926.

10. McHenry, D. D.: Vincent's Disease, J. Oklahoma M. A. **20**:221, 1927.

11. Ellerman, in Sebeng, C.: L'angine de Vincent, Thèse de Paris, 1919.

the invasion of the tissues. On this basis, she distinguished three zones of the local pathologic area, the innermost containing the greater abundance of the spirochetes. Her observation gives weight to the contention that the spirochete is responsible for the spread of the disease. (The accompanying photomicrographs show the detailed pathology of the invasion of spirochetes.)

Mangabeira Albernaz,[12] the foremost observer of this disease in South America, agreed with Tunnicliff that the spirochetes are the

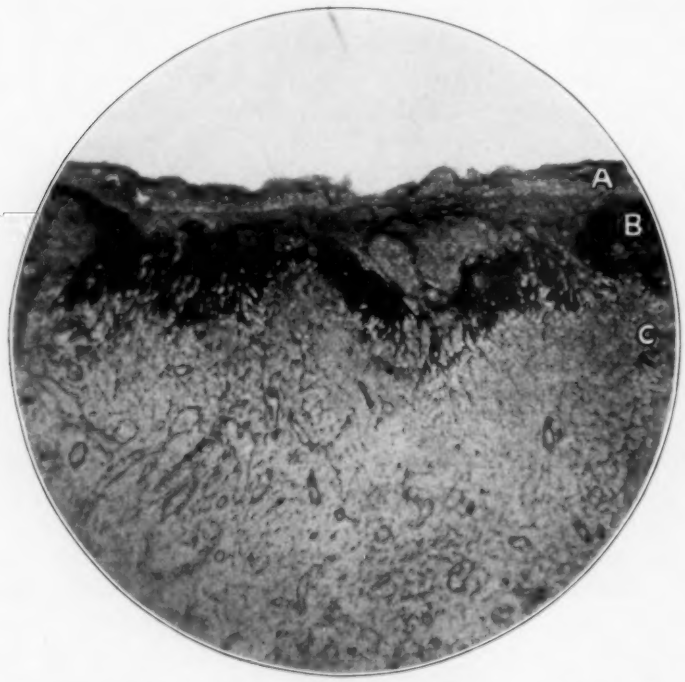

Fig. 1.—Section through the tonsil, showing external necrotic layer (*A*) containing practically no bacteria. The middle layer (*B*) is made up of masses of fusiform bacilli and spirochetal forms, and living tissue (*C*). Levaditi preparation; × 90.

invaders and produce the extensive destruction of tissues, and that the odor is due to the action of the bacilli. This is the general consensus of present-day observers. It is impossible to classify or to state precisely the nature and the number of spirochetes that normally exist in the mouth.

12. Mangabeira, Albernaz P.: Bismuth in angina de Vincent, J. d. clin. **23**: 355 (Dec. 15) 1922; Le therapeutique de l'angine de Vincent, Arch. internat. de laryng. **30**:917, 1924.

UNUSUAL AND FATAL CASES

In reviewing the literature, one is impressed with the voluminous reports of Vincent's infection associated with other conditions and their possible relationship. A brief résumé is included because of general interest. Jones reported a fatal case of Vincent's infection with acute yellow atrophy; one of gallstones and one of gastric ulcer and an instance in which Vincent's organisms were isolated from the urine of a patient suffering from prostatic stone.

Newkirk, Packard and Flood [13] and Sondern reported cases of acute myeloblastic leukemia with Vincent's angina. Sondern even ventured the

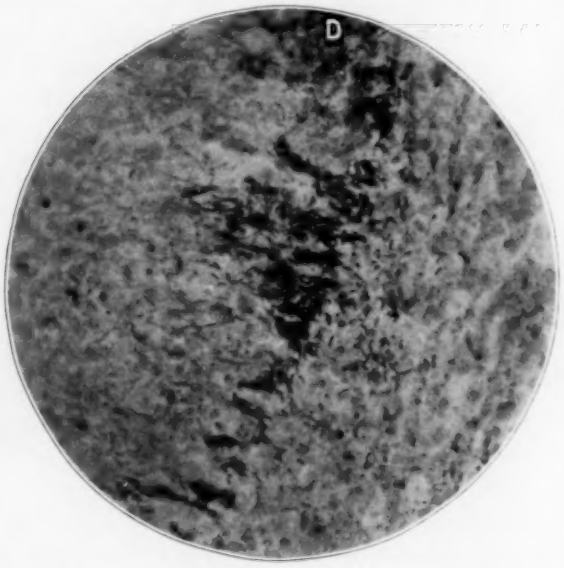

Fig. 2.—Section through the edge of the middle layer, showing the organisms invading living tissue. The spiral forms are in advance of the bacilli. A mass of spiral organisms is seen at (*D*). Levaditi preparation; × 450.

assertion that association of Vincent's infection and leukemia means certain fatality. Fehenfeld and Carr expressed the belief that herpes zoster is closely associated with this disease. Jameson [14] and MacGruer and Rubenstein [15] reported several cases of pemphigus associated with Vincent's angina.

13. Packard, M., and Flood, E. P.: Pathogenesis of Acute Leukemia: Report of Case of Acute Myeloblastic Leukemia, with Association on Complication of Vincent's Angina, Am. J. M. Sc. **160**:883, 1920.

14. Jameson, R. E.: Vincent's Angina Developing During Arsenical Treatment for Lues, Clin. Med. & Surg. **32**:103, 1925.

15. MacGruer, H. A., and Rubenstein, A. H.: Acute Pemphigus of Throat with Positive Vincent's Angina, Arch. Otolaryng. **3**:259 (March) 1926.

Felderman [16] expressed the opinion that extensive Vincent's angina with leukopenia and an increase of mononuclears constitutes the picture of agranulocytic angina. Numerous observers reported eruptions of the skin with Vincent's angina; some of them were scarlatiniform, others purpuric, erythema multiforme-like lesions and still others bullous lesions. Vincent's organisms have been isolated from mastoid antrums, pulmonary abscesses, pericardial sacs, salivary calculi and other conditions. In a careful survey of the literature only one proved case of spirillemia was found; this was confirmed by a culture made at necropsy. Many cases of severe ulceration have been reported, such as in tropical ulcers of the leg and of the palate, military wounds and other types of injury. One unusual report describes the destruction of the right

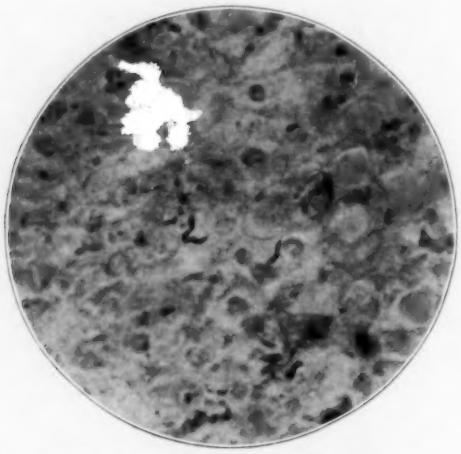

Fig. 3.—Section showing spiral organisms invading living tissue just in advance of the bacilli. Levaditi preparation; × 1,200. (After Tunnicliff.)

tonsil, the palate and the uvula, with erosion of the carotid artery, which after ligation resulted in recovery. A fair number of patients have also been observed with Vincent's infection of the gums associated with a recurrent enteritis with diarrhea, who invariably recovered under treatment for the local condition.

Hemorrhage following tonsillectomy has been attributed to Vincent's infection with the occasional formation of a pulmonary abscess, and at autopsy other lesions of the mouth have been demonstrated. Is this a possible clue to the origin of some of the abscesses of the lungs? Infective material from all of the abscesses of the lung should be examined microscopically as well as by culture.

16. Felderman, L.: Is Agranulocytic Angina a Terminal Stage of Vincent's Angina? Eye, Ear, Nose & Throat Monthly **9**:10 (Feb.) 1930.

Jelinek [17] reported the case of a patient with paronychia of the middle finger, microscopically showing Vincent's organisms, and Arnold [18] a case of Vincent's disease of the vagina. Held reported the complete destruction of the tympanic membrane in acute disease of the middle ear, apparently the result of Vincent's disease. Five other cases are reported. Fanton emphasized correctly the importance of a fetid odor in suppurative otitis media. In such instances, particularly if there are shreds of membrane in the discharge, it is always wise to make a smear for Vincent's organisms as well as to cultivate the material for diphtheria bacilli. Fanton reported one instance in which these micro-organisms were demonstrated in pus from a case of suppurative meningitis following chronic otitis media with Vincent's infection.

Bloodgood [19] made the interesting observation that never has Vincent's disease been reported in a patient whose teeth and tonsils have been removed; likewise, it has never been noted in a person persistently addicted to chewing tobacco (Moriarity [20]).

TREATMENT

A review of the literature regarding the drugs used in the treatment for Vincent's infection impresses one with the many empirically suggested but scientifically unsubstantiated methods. Considered theoretically and scientifically, the drugs employed should be readily absorbed by the tissues in order that they may penetrate deeper than the surface tissues; they should have active antiseptic action for an appreciable period, being neither readily dissolved nor neutralized by direct contact with the tissues. They should be neither caustic nor destructive of tissue; otherwise, the field for the multiplication of bacteria is both increased and enriched. Ideal drugs should have a surface-dissolvent action on the necrotic tissues. They should have an antiseptic action active on one or the other components of the symbiosis, for if one of these is eliminated, the symbiosis is destroyed. The multiplicity of therapeutic agents now used in the management of this condition indicates all too well how far the medical profession has failed in satisfying the foregoing conditions.

Only the most important drugs will be mentioned, owing to the many variations of treatment suggested. Silver nitrate, in from 5 to 25 per cent solution, is an efficient astringent in Vincent's infection. Of the caustics, chromic acid (5 per cent) and trichloracetic acid are the most

17. Jelinek, V.: New Observations on Stomatitis and Plaut-Vincent's Angina, Acta oto-laryng. **11**:553, 1927.

18. Arnold, C. H.: Plaut-Vincent's Infection of the Vagina, J. A. M. A. **94**: 1461 (May 10) 1930.

19. Bloodgood, J. C.: Oral Lesions Due to Vincent's Angina, J. A. M. A. **88**: 1142 (April 9) 1927.

20. Moriarty, L. J.: Clin. Med. & Surg. **36**:108 (Feb.) 1929.

reliable. Cupric sulphate in from 10 to 50 per cent freshly prepared aqueous solution is effective both as a mouth wash and locally in the more concentrated strengths, but the danger of local copper poisoning, especially of the buccal mucous membranes, should always be kept in mind. Phenol and ethyl chloride, which are frequently mentioned in the literature, are of little value. The aniline dye group deserves mention because of a more prolonged local antiseptic action. The irrigating solutions include potassium permanganate and potassium chlorate; locally, sodium perborate and hydrogen dioxide are excellent oxidizing agents and are more effective if used hot, especially in acute cases. The various methods of physical therapy, such as ultraviolet light, diathermy and the x-rays, are of little value.

The chief drugs to be remembered are the spirocheticides, which include potassium arsenite, the arsphenamine group and the salts of bismuth. Beck and Kerl [21] mentioned arsphenamine as specific if used locally in direct contact for from ten to fifteen minutes. Laurens [22] showed that the solvent action of bismuth salts on necrotic tissue is greater and also less toxic than that possessed by the arsenical preparations.

Bismuth preparations have been used more extensively in Europe than in America. Bismuth and sodium tartrate in 1.5 per cent aqueous solution is advised for intramuscular use, and the glycerinated solution of the same strength for topical application. This combination furnishes the best and most satisfactory treatment thus far advocated.

CONCLUSIONS

1. Plaut-Vincent's infection is a localized fusospirochetosis.

2. Accepted opinion supports the theory that the fusiform bacillus and the spirochete are different forms in the life cycle of the same organism.

3. Judged by the extent of necrosis and distribution throughout the body, Vincent's infection is more severe in the tropics than in temperate or arctic climates.

4. Well supported evidence that Vincent's infection is communicable makes advisable the recommendation that it be universally reported under epidemic conditions. Control measures should include isolation.

5. The possible relationship of agranulocytosis and Vincent's angina requires further investigation.

6. The use of bismuth preparations constitutes the best form of treatment, for they are less toxic, more powerful and more economical.

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21. Beck, O., and Kerl, W.: Die Angina necrotica, Vienna, Moritz Perles, 1924.

22. Laurens, P.: Traitement de l'angine de Vincent par les applications locales de bismuth, J. d. praticien. **12**:740 (March 21) 1925.

ULTRAVIOLET LIGHT IN TUBERCULOSIS OF THE LARYNX *

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LOS ANGELES

The method of treating patients for tuberculosis of the larynx with the sun's rays was introduced in 1904 by Sorgo [1] of Davos, Switzerland, who devised a system of mirrors for reflecting the rays into the larynx. Ten years later, Phillip [2] improved Sorgo's method by using a concave mirror reflector instead of Sorgo's plain mirror.

PHYSICAL PROPERTIES AND THERAPEUTIC ACTION OF LIGHT

The scientific study of the physical properties and therapeutic action of the sun's rays and artificial ultraviolet light was carried out by many authors, and the following is a short summary of their observations.

Sunlight contains the shorter ultraviolet rays, the visible light and the invisible infra-red rays. The shorter ultraviolet rays are found only in small quantities at sea level. The mercury quartz light contains an abundance of these short ultraviolet rays. Seventy per cent of the radiation emitted by the mercury vapor light consists of ultraviolet rays. The most effective rays for therapeutic purposes are the ultraviolet, as the bactericidal power of light depends on these rays. The heat rays (red and infra-red) produce hyperemia, which prevents the absorption of the ultraviolet rays and interferes with the therapeutic action of the light, as was demonstrated by Finsen.[3]

The glass mirrors, which were used for reflecting the light into the larynx, absorbed the greater part of the therapeutic rays and reflected only about 9 per cent of them. This situation was reversed in 1918, when Mills and Forster,[4] of Colorado Springs, published an article describing a system of concave mirrors, invented by Mr. Verba, which were prepared from a metallic alloy of aluminum and magnesium. These mirrors reflect a high percentage of the ultraviolet rays and absorb the

* Submitted for publication, Jan. 10, 1931.
* Read at a Meeting of the Trudeau Society of Los Angeles, Dec. 30, 1930.

1. Sorgo, Josef: Wien. klin. Wchnschr. **17**:12, 1904.
2. Phillip, L., and Archamband, M.: Gaz. d. hôp. **87**:1387, 1914.
3. Finsen: Mitteilungen aus Finsens Medicinske Lysinstitut in Kopenhagen, Leipzig, F. C. W. Vogel, 1903.
4. Mills, Charles W., and Forster, Alexius M.: The Treatment of Laryngeal Tuberculosis by Reflected Condensed Sun Light, Am. Rev. Tuberc. **2**:699, 1918-1919.

heat rays, thereby preventing the undesirable negative action of the hyperemia that is produced by the heat rays.

EXPERIMENTAL WORK ON THE THERAPEUTIC ACTION OF LIGHT IN TUBERCULOSIS

There is a great deal of experimental work that proves the local action of light on bacteria.

Koch demonstrated that the tubercle bacillus was rapidly killed by direct sunlight. Krusius was able to delay the development of experimental corneal tuberculosis in rabbits by exposure to sunlight immediately after inoculation. Jansen showed that he could kill bacteria through the skin at a depth of 1.5 mm. Henry and Baron proved that the rays of a mercury quartz light killed tubercle bacilli in ten minutes. The ultraviolet rays produce either stimulation of the tissue with short exposures or destruction with longer ones. This was demonstrated by Hess with the epithelial cells of the capsule of the lens, by Bovie with unicellular organisms and by Lutz with cells of epidermis. Jansen, by his study of the histologic changes in the tubercles of a rabbit's cornea, was able to demonstrate that large doses of ultraviolet rays produce destructive effects, such as dilatation of vessels, partial thrombosis and destruction of giant and epithelioid cells with final vacuolation and necrosis (Edgar Mayer [5]). Mayer and Dworsky,[6] in 1924, experimentally showed that ultraviolet light favorably influenced the healing of corneal tubercles in rabbit eyes.

One of the arguments against ultraviolet light is that the penetration of its rays is not deep enough for proper action. Macht, Anderson and Bell,[7] however, demonstrated that the penetration of actinic rays is much greater than had been supposed. They introduced the barrel of a spectrograph under the skin of a living rabbit in one instance and entered the peritoneal cavity in another, finding that the rays could pass through the skin and the whole thickness of the abdominal wall. An indirect proof of this fact can be found in the report of Ude and Platou,[8] who produced a clinical arrest of erysipelas by the first treatment with ultraviolet light in 92 per cent of their cases. It is known that in erysipelas streptococci accumulate in large quantities in the lymphatic vessels of the skin. To arrest the disease,

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5. Mayer, Edgar: Sun Light and Artificial Light Therapy in Tuberculosis, Am. Rev. Tuberc. **5**:99, 1921-1922.

6. Mayer, Edgar, and Dworsky, Morris: Am. Rev. Tuberc. **10**:146, 1924.

7. Macht, D.; Anderson, W., and Bell, F.: The Penetration of Ultraviolet Rays into Live Animal Tissues, J. A. M. A. **90**:161 (Jan. 21) 1928.

8. Ude, W. H., and Platou, E. S.: Erysipelas: A Comparative Study of the More Recent Methods of Treatment, J. A. M. A. **95**:2 (July 5) 1930.

the ultraviolet rays in this instance had to penetrate the skin and kill the micro-organisms in the vessels.

The aforementioned experimental facts are in accordance with clinical observations of many physicians, such as Tillman [9] of Stockholm, Collet [10] of Lyon, Sari [11] of Paris, Blumenthal [12] of Berlin, and Mills and Forster, Edgar Mayer and others of this country. They definitely prove the favorable action of light therapy in laryngeal tuberculosis.

TECHNIC OF DIFFERENT METHODS

By the proper technic the ultraviolet rays of sunlight can be applied to the treatment for laryngeal tuberculosis.

Fig. 1.—Treatment of the larynx with sunlight.

The best time for the sun treatments is between 10 and 11 a. m. To avoid sunburn of the larynx, it is advisable to begin the treatment with exposures of two or three minutes, gradually increasing the time to ten minutes. The method of reflecting the sun's rays into the larynx by a system of metallic mirrors is easily understood from figure 1. The patient is seated on a chair with his back to the sun; the rays are reflected into his mouth by a metallic mirror. By manipu-

9. Tillman, J.: Hygiea **9**:318, 1910.
10. Collet: Rev. de laryng. **2**:222, 1914-1915; Lyon méd. **38**:9, 1906.
11. Sari, E.: Rev. de laryng. **25**:33, 1914.
12. Blumenthal, A.: Arch. f. Laryng. u. Rhin. **27**:362, 1913.

lating a small laryngeal mirror in the same way as in a laryngeal examination, the patient reflects the rays into the larynx. The treatments are performed every day with short intervals of rest whenever signs of irritation arise.

Edgar Mayer uses a direct method of applying artificial ultraviolet rays to the larynx. The source of radiation is a lamp with a small mercury quartz water-cooled apparatus similar to the Kromayer lamp (fig. 2). This lamp can be easily handled and is not too large for insertion into the mouth. Mayer reported thirty-five cases of laryngeal tuberculosis in which this method gave encouraging results.

Fig. 2.—Mayer's lamp.

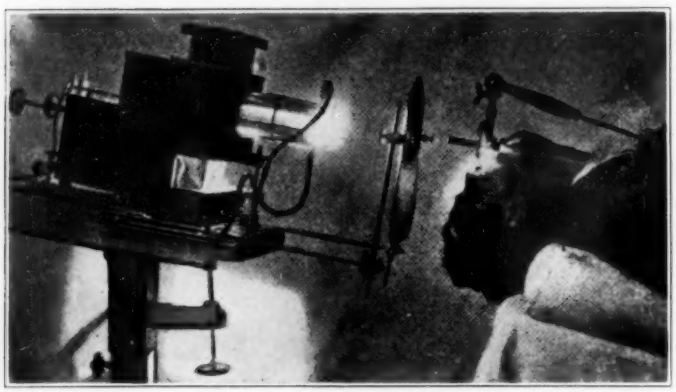

Fig. 3.—Wessely's method of irradiation of the larynx.

The work of Wessely [13] of Vienna, published in 1924, can be mentioned as one of the latest developments in artificial light therapy. Wessely's method consists of direct irradiation of the larynx with artificial ultraviolet rays by means of the Seiffert universal direct laryngoscopy. This method is complicated, requiring suspended laryngoscopy for every treatment. Wessely uses the indirect method also

13. Wessely, Emil: Eine neue Methode bei Behandlung der Tuberculose der oberen Luftwege mittels lokal applizierten kunstlichen Lichtes, Wien. klin. Wchnschr. **37**:611, 1924.

for irradiation of the larynx from an artificial source, the technic being the same as that described by Mills and Forster in applying the sun's rays. According to Wessely and Miller,[14] of New York, who used Wessely's method in this country, superficial tuberculous ulcers heal under this treatment.

CRITICAL CONSIDERATIONS

Aside from the clinical and experimental observations of the aforementioned authors, there is the opinion of Strandberg,[15] who claimed that the results from the local projection of light into the larynx are due to a general action on the whole body of the light that is absorbed through the fauces. He advocated general irradiation of the entire body for laryngeal tuberculosis.

The critical considerations that Strandberg brought out in regard to local treatments of the larynx with light can be formulated into four points: 1. Very small quantities of light can be directed into the larynx. This statement is in contradiction to the fact that actual burns can be easily produced on the mucosa of the larynx if the exposure to light is prolonged beyond the proper limits (Jelinek[16]). 2. Mirrors reabsorb too great a quantity of the chemical components of light. This consideration is correct so far as glass mirrors are concerned, but is not applicable to the mirrors prepared from Verba's special alloy. The latter do not absorb the actinic rays (Mills and Forster). Furthermore, it is not correct in regard to the direct method of insertion of light without the aid of mirrors. 3. It is difficult, if not impossible, to light up the actually affected spots. 4. The amount of light that reaches the throat would be very small, as there is a considerable distance between the source of light and the spot to be treated (Strandberg).

MODIFIED TECHNIC

Having found the last two points worthy of consideration, I modified the technic by directly inserting into the larynx a long rodlike quartz applicator attached to a Kromayer lamp. This quartz applicator introduced through a direct laryngoscope, with a small electric globe attached, makes possible direct contact of the ultraviolet light with the affected area under the control of the eye. For the sake of simplicity, I am using a laryngoscope attached to a handle which contains a dry battery

14. Miller, W. Joseph: Treatment of Laryngeal Tuberculosis with the Goerz-Wessely Lamp, M. J. & Rec. **123**:166 (Feb.) 1926.

15. Strandberg, Ove: Heliotherapy and Artificial Light: Treatment of Tuberculous Conditions and Particularly Laryngeal Tuberculosis, J. A. M. A. **90**:1595 (May 19) 1928.

16. Jelinek, D.: Heilung und Besserung der Kehlkopf- und Nasentuberculose durch blosse Applikation des Lichtes der Quarzlampe, Monatschr. f. Ohrenh. **62**:63, 1928.

as a source of light for the illumination of the larynx. The patient lies supine on a table with the head fully extended. The exposure lasts two minutes and is repeated every third or fourth day. Gradually, in accordance with individual tolerance, the dose is increased to five minutes. The mucous membranes, probably owing to the presence of moisture and an abundance of blood supply, tolerate ultraviolet radiation much better than the skin. Finsen [17] demonstrated that the ultraviolet rays are absorbed by the blood. Pottenger [18] made the same statement. Therefore, a close contact of ultraviolet light with the mucous membranes is not only possible but indicated and is accomplished for the first time by my technic.

Fig. 4.—Modified technic.

COMMENT

Laryngeal tuberculosis is part of a general tuberculosis. Therefore, improvement of the larynx depends most of all on the general condition of the patient. That general irradiation with ultraviolet light is beneficial in tuberculosis has been proved by many authors. The improvement depends on the change in calcium metabolism. While some think that this general action of light is the most important, the experimental and clinical observations mentioned prove that the local action is also of significance.

17. Finsen, quoted by Mayer (footnote 5, p. 85).

18. Pottenger, F. M.: A Discussion of Certain Principles Involved in Heliotherapy, Am. Rev. Tuberc. **14**:496 (Nov.) 1926.

As far as the larynx is concerned, my contention is that treatments with ultraviolet light are of value as an auxiliary measure.

Although some physicians depend only on ultraviolet light in treating patients for tuberculosis of the larynx, I am not enthusiastic about resorting to this method alone.

If ulceration of the larynx is present, treatments with trichloracetic acid are indicated, as I [19] described in a previous article. In cases of edema or infiltration, electrocauterization is the method of choice. Because the pain and inflammatory reaction after electrocauterization depend to a certain extent on secondary infection of the wound, it is my practice to cover the cauterized area with trichloracetic acid immediately after electrocauterization. This acid forms a white slough on the wound which prevents secondary infection with ordinary and tuberculous germs. The application of the acid likewise decreases pain from the reaction and increases the subsequent shrinkage of the infiltration or edema.

1052 Roosevelt Building.

19. Katz, Benjamin: The Treatment of Laryngeal Tuberculosis with Trichloracetic Acid, Am. Rev. Tuberc. **21**:636 (May) 1930.

CARCINOMA OF THE SPHENOID SINUSES WITH INVASION OF THE CRANIAL CAVITY*

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AND
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Carcinoma of the sphenoid sinuses is rare. A careful search of the literature shows only two cases of malignant disease of the sphenoid sinuses, which were recorded by White [1] among 125 patients with retrobulbar neuritis. The diagnosis of malignancy was made on biopsy material. Death was due to involvement of the central nervous system in the form of basilar meningitis. The two cases to be reported were diagnosed during life; in both, autopsy showed invasion of the cranial cavity compressing the adjacent nervous structures.

REPORT OF CASES

CASE 1.—M. F., a man, aged 43, a furrier, was admitted to the Montefiore Hospital on Nov. 17, 1927. In November, 1926, the patient had complained of difficulty in nasal breathing. He was subject to frequent colds. In May, 1927, following a submucous resection he experienced shooting pain in the nose and the right eye, boring pain in the right frontal region and buzzing in both ears. Early in November nausea, vertigo, difficulty in swallowing and a sensation of tightness of the entire face developed. The past and family histories were unimportant.

General and neurologic examination showed a bilateral anosmia; fulness of the veins of the fundi without papilledema; a larger right than left pupil, both reacting to all stimuli; weakness of the right internal rectus; ptosis of the right lid; weakness of both right and left external recti; right corneal hypesthesia; hypalgesia in the distribution of the right ophthalmic branch of the fifth nerve, and hypesthesia and hypalgesia in the distribution of the left fifth nerve; a right supranuclear facial palsy; tinnitus in both ears; deviation of the uvula to the left, diminution in the movements of the right side of the palate and difficulty in swallowing; deviation of the tongue to the right. All the deep reflexes were markedly exaggerated, and a bilateral Babinski sign and allied reflexes were elicited.

Roentgen examination showed an enlarged sella turcica, with the posterior clinoid processes partially destroyed. The nasal accessory sinuses were normal. There was a metastatic nodule of the sixth rib. All other laboratory data were negative.

The patient became progressively worse, and six weeks before death bilateral enlargement of the submaxillary glands developed which on biopsy proved to be

* Submitted for publication, Feb. 16, 1931.

* From the Neuropathological Laboratory and Neurological Division, Montefiore Hospital.

1. White, L. E.: Disturbances of Optic Nerve Caused by Malignant Disease of the Sphenoid, Arch. Otolaryng. **6**:361 (Oct.) 1927.

epidermoid carcinoma. Bronchopneumonia developed, and the patient died on Jan. 17, 1928.

The neurologic diagnosis was an inflammatory or neoplastic process of the sinus with extension into the middle and posterior fossae. The anatomic diagnosis was: squamous cell carcinoma of the sphenoid sinus, with invasion of the sphenoid bone into the middle and posterior fossae and the nasopharynx, metastases to the cervical lymph nodes, liver and ribs, and terminal bronchopneumonia.

Fig. 1.—Section through the pituitary gland and floor of the sella turcica showing the invasion of the bone by tumor tissue and thickening of the dura: *a*, pituitary gland; *b*, dura, and *c*, sella turcica. Van Gieson stain; × 100.

Autopsy.—Gross Examination: The right sphenoid sinus was filled with a soft, whitish, gelatinous tissue, which had invaded and replaced the anterior portion of the sphenoid sinus and had completely destroyed the floor of the sella turcica (fig. 1). The anterior lobe of the pituitary gland did not show any abnormality, but the margin of the posterior lobe was gelatinous and discolored. The left supra-orbital fissure and the cranial nerves entering at this level were surrounded

by tumor tissue. The right supra-orbital fissure was not involved. The pia-arachnoid at the base of the brain, extending from the chiasm to the medulla oblongata, was infiltrated with blood.

Microscopic Examination.—The tumor mass was made up of large, irregular nests and anastomosing cords of cells with abundant fibrous tissue. The cells had a distinctly epidermoid character and showed a tendency to stratification (fig. 2). Prickle cells were seen in many places, but there was no pearl formation. In the

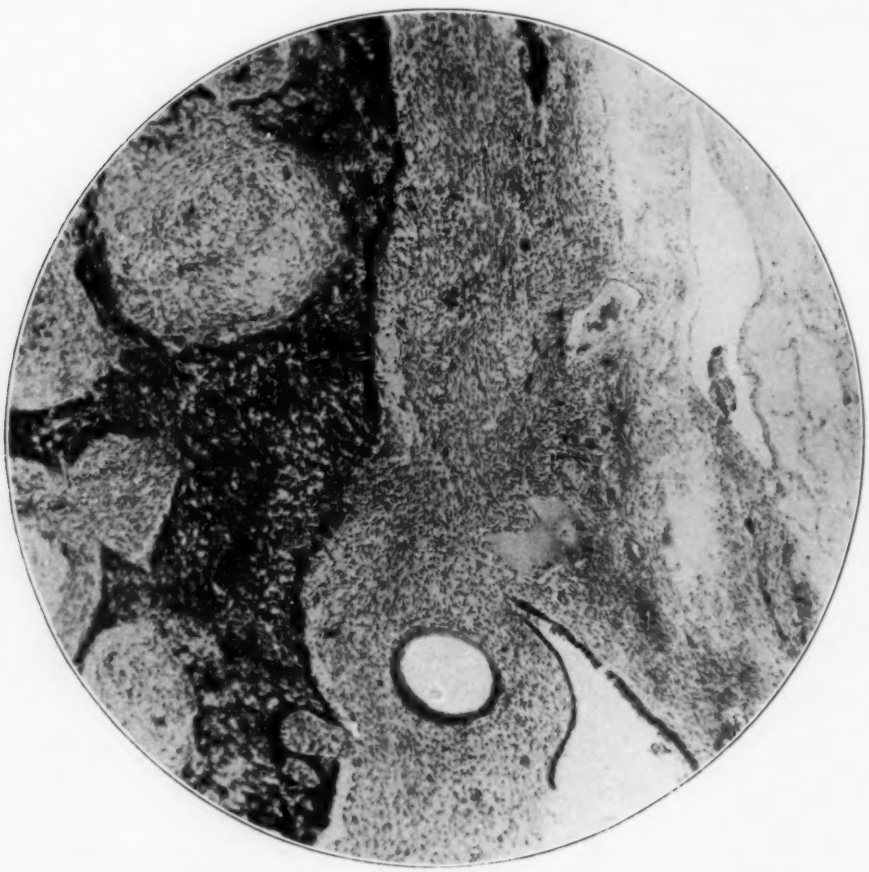

Fig. 2.—Section showing the epidermoid character of carcinoma. Hematoxylin-eosin stain; × 70.

center were small and large areas of pink-staining material in which nuclei and outlines of spindle-shaped cells were scattered. The stroma was infiltrated by lymphocytes and plasma cells. There was a large amount of intercellular substance which in places had a myxomatous appearance.

The nerve fibers of the left supra-orbital fissure were surrounded by bands of connective tissue (fig. 3). In the fibrous tissue numerous cells were found, similar to those noted in the tumor mass (fig. 3). The nerve fibers were preserved and were not markedly demyelinated. Except for the margins of the posterior lobe,

which were invaded by a fatty myxomatous tissue, and a few nests of tumor cells the rest of the pituitary gland was normal.

The microscopic diagnosis was carcinoma of the sphenoid sinuses with invasions of the sella turcica and supra-orbital fissure.

Comment.—The neurologic signs in this case showed involvement of the first, third, fifth, sixth, seventh, eighth, ninth, tenth and twelfth cranial nerves. The anosmia was probably postoperative. The signs

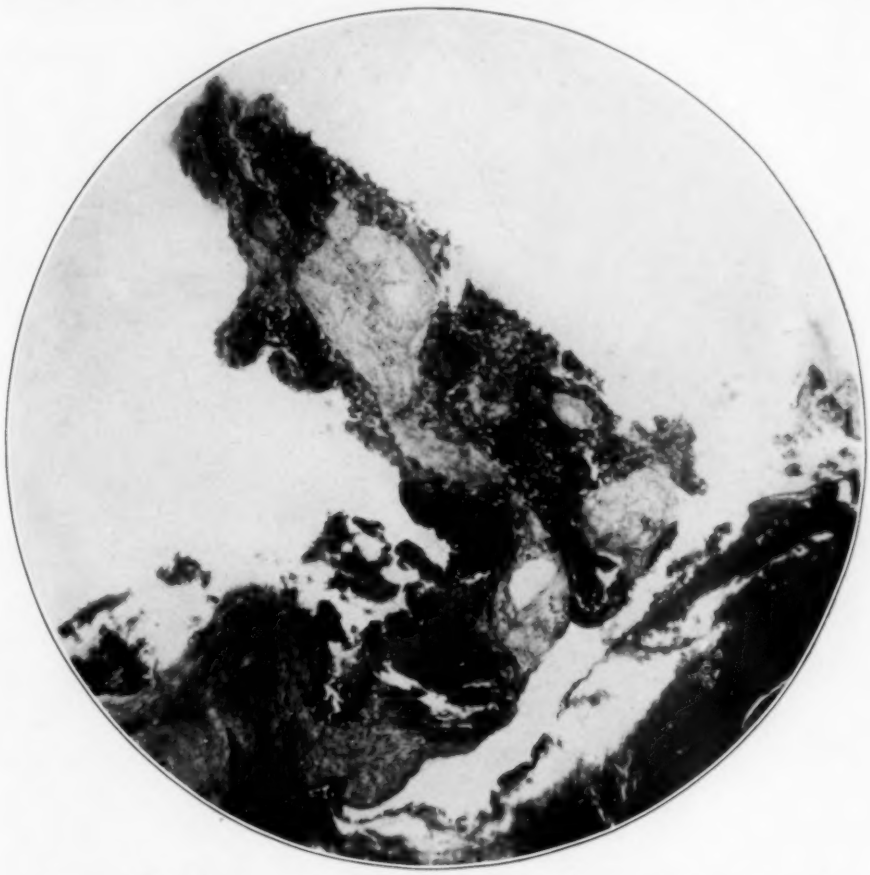

Fig. 3.—Section through the left supra-orbital fissure showing the cranial nerves surrounded by tumor tissue. Van Gieson stain; × 50.

referable to the other cranial nerves and the pyramidal tracts were due to compression by the tumor and not to direct invasion of the nervous structures. In spite of the destruction of the sella turcica by the tumor, the optic nerves were spared. The erosion of the sella turcica, as evidenced in roentgenograms, should early have suggested the presence of a neoplasm.

CASE 2.—H. K., a man, aged 55, an ironworker, was admitted to the Montefiore Hospital on Oct. 7, 1927. In October, 1925, the patient had complained of difficulty in breathing. During the following year he was subjected to a number of operations: bilateral sphenoid ethmoidectomy, submucous resection and tonsillectomy. In December, 1925, bilateral cervical lymphadenitis was noted, which on biopsy proved to be tuberculous adenitis. In February, 1927, after a second sphenoid-ethmoidectomy, palsy of the external rectus muscles developed. A diag-

Fig. 4.—Tumor tissue, consisting of irregular cords and nests of epithelial cells lying in an abundant fibrous stroma. Van Gieson stain; × 50.

nosis of neoplasm was then considered, which was definitely confirmed by a second biopsy of the cervical gland. In August, 1927, a left-sided nerve deafness developed, accompanied by severe occipital headaches, dizziness and tinnitus. The family and past histories were unimportant.

Physical examination revealed a poorly nourished middle-aged man with tenderness over the frontal sinuses, and enlarged, firm, discrete cervical lymph nodes. Neurologic examination showed: bilateral anosmia; normal optic nerves;

bilateral ptosis of the eyelids; paralysis of the left external rectus; left corneal hypesthesia; left peripheral facial palsy; absence of taste in the left half of the tongue; eighth nerve deafness on the left side; decreased movement of the left side of the soft palate on phonation; difficulty in swallowing, and hoarseness; slight weakness of the left sternocleidomastoid muscle, and fibrillations of the tongue. All the deep reflexes were normal. There was adiadokokinesis on the left.

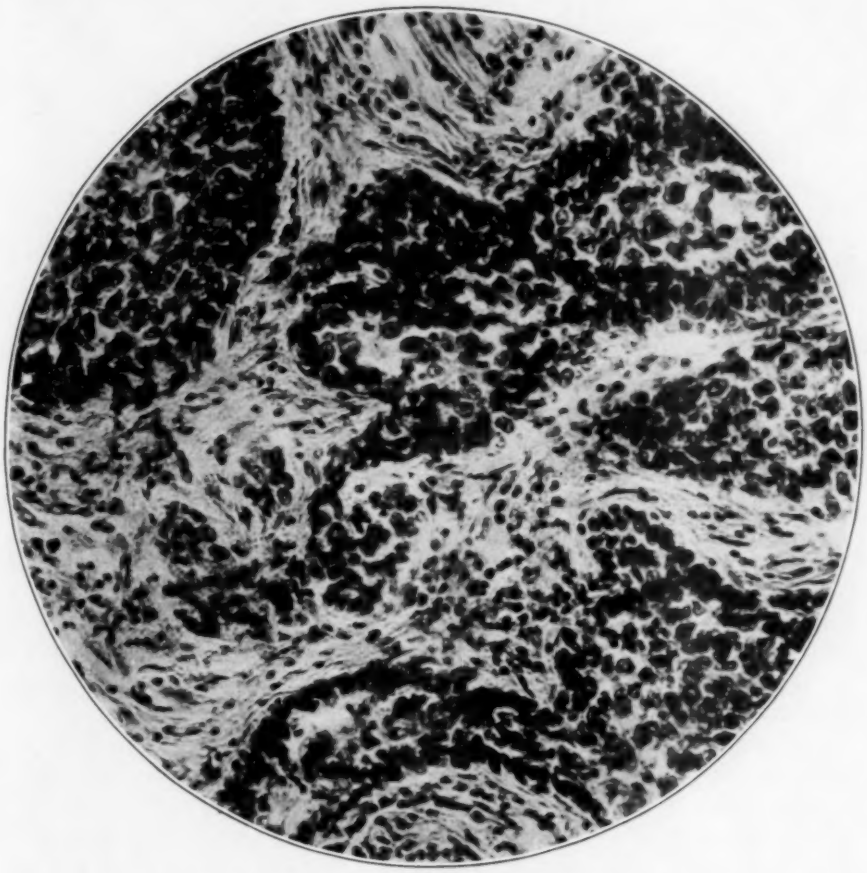

Fig. 5.—The same area shown in figure 4; × 240.

A roentgenogram of the skull showed increased density of both antrums and the right frontal sinus. The sella turcica was normal. All other laboratory data were negative.

The patient received deep roentgen and radium treatment without beneficial results. He died of terminal bronchopneumonia on Oct. 23, 1927.

The clinical diagnosis was carcinoma of the sphenoid with invasion of the middle and posterior fossae. The anatomic diagnosis was: carcinoma of the sphenoid with an extension into the cranial cavity compressing the pons, medulla, cerebellum and the cranial nerves; metastases to the retropharyngeal and cervical lymph nodes, and terminal bronchopneumonia.

Autopsy.—Gross Examination: On removal of the brain, a whitish-gray tumor, 3.5 cm. in diameter, was found projecting through the dura over the left half of the sphenoid bone, behind the left greater wing. The tumor had extended backward, compressing the left side of the pons, medulla oblongata, cerebellum and the fourth to tenth cranial nerves. Sagittal and cross sections through the base of the skull showed that the right anterior half of the sphenoid body was replaced by tumor tissue, which had eroded the sella turcica and invaded the anterior lobe of the pituitary gland. The tumor partially filled both sphenoid sinuses and infiltrated the roof of the nasopharynx.

Microscopic Examination: The tumor consisted of irregular cords and nests of epithelial cells lying in an abundant fibrous stroma (fig. 4). Under higher magnification these cells appeared irregular, polygonal and flattened, suggesting a palisade arrangement (fig. 5). Prickle cells and pearl formations were not seen. Some sections showed extensive areas of necrosis, infiltrated by round cells.

The ventral surface of the pons and medulla was irregularly eroded. The zone adjacent to the tumor showed an increase of glia nuclei. Between the nerve fibers and glia meshes of this degenerated area were scattered numerous tumor cells.

Comment.—The outstanding neurologic observations in this case were somewhat similar to those in case 1, i. e., compression of the pons, medulla oblongata and the cranial nerves, but not the optic nerves. The diagnosis of neoplasm was considered when paralysis of the external recti was noted; this was later confirmed by microscopic examination of biopsy material from the cervical lymph glands. The interesting feature in this case was the negative roentgen indications in the sella turcica, although autopsy revealed erosion by the tumor mass which had invaded the anterior lobe of the pituitary gland.

COMMENT AND CONCLUSIONS

The two cases reported in this article had a similar history, the course and terminal process being identical. The neurologic signs were due to the direct extension of the tumor into the middle and posterior fossae, compressing practically all the cranial nerves. Invasion of the nervous parenchyma was not observed. In contrast to White's cases, meningeal signs were not present, although there was invasion of the posterior fossa by tumor tissue. Our cases did not show evidences of retrobulbar neuritis, which is frequently observed in sinusitis and in malignant conditions of the sinuses. The optic nerves, chiasm and radiations were spared, despite erosion of the sella turcica, although there was roentgen evidence of this in the first case. A normal roentgen appearance does not invalidate the fact that the sella turcica may be destroyed, as shown in the second case. The same difficulty is frequently encountered in suspected neoplasms of the pituitary gland. Repeated stereoscopic plates of the sella might solve this problem.

In suspected cases of sinusitis, which are not relieved by operative intervention, it is advisable to examine the sella and posterior sinuses and to make a careful neurologic examination. This may lead to an early diagnosis of a malignant condition of the sphenoid sinuses. As to treatment in these cases, except for deep roentgen ray therapy, which is only palliative, there is little to be offered.

OSTEOMA OF THE NASAL SEPTUM

WITH A LARGE EPIDURAL ABSCESS; OPERATION; RECOVERY *

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CINCINNATI

Osteomas arising from the nasal septum are so rare that in a careful search of the literature I was able to find only Guthrie's [1] case, in which a hard mass was palpated in the nasopharynx and was later detached from a small bony pedicle near the posterior margin of the septum and pushed into the pharynx.

The greatest number of osteomas of the nose and orbit have been reported in patients from 17 to 35 years of age, and their origin has been from the ethmo-orbital wall or from various locations in the frontal sinus.

Andrew reported eight bony growths in 430,000 patients examined in the course of several years in the leading eye clinics of New York.

Harris,[2] in the report of two of his own cases, stated that twenty-eight osteomas of the frontal sinuses were reported in the literature from 1907 to 1927. Among these cases was one of a large frontal osteoma extending into the anterior cerebral fossae, which I [3] reported before the Cincinnati Academy in 1925. The majority of the cases were reported by European surgeons prior to 1918.

Cushing [4] stated that his first introduction to an ethmo-orbital osteoma was in 1924, and in his four cases reported in 1927, all the growths apparently had their origin in the region of the suture between the orbital plate of the frontal bone and the adjacent edge of the ethmoid bone roofing the ethmoid cells.

This origin seems to coincide with Virchow's theory that they may arise from a cartilaginous anlage which has been stimulated to bone-productive activity.

However, many theories have been advanced, such as trauma, unsuspected fracture, infections of the sinuses and proliferating periostitis.

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* Submitted for publication, Dec. 27, 1930.

* Read before the Cincinnati Ear, Nose and Throat Society, Dec. 16, 1930.

1. Guthrie, T.: Osteoma of Septum: Case, J. Laryng. & Otol. **45**:189, 1930.

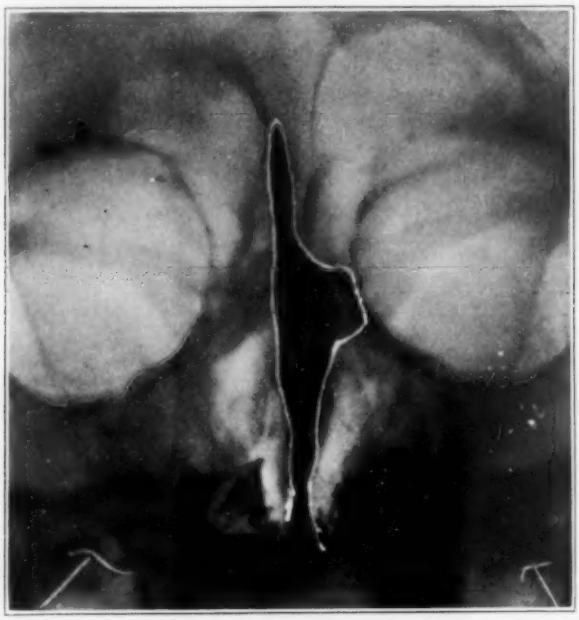
2. Harris, R.: Osteoma of the Frontal Sinus: Report of Two Cases, Laryngoscope **38**:331, 1928.

3. Goodyear, H. M.: Osteoma of the Frontal Sinus Extending into the Orbit and Anterior Cerebral Fossa, Laryngoscope **35**:751 (Oct.) 1925.

4. Cushing, H.: Experiences with Orbito-Ethmoidal Osteomata Having Intra-Cranial Complications, with Report of Four Cases, Surg. Gynec. Obst. **44**:721, 1927; Tr. Am. S. A. **45**:1, 1927.

Headache and external deformities are probably the most common symptoms, and accompanying infections of the sinuses are frequent. The roentgenogram is probably the most important factor in the diagnosis and in differentiating the growths from meningiomas.

The case that I am presenting illustrates the importance of a careful and minute examination of the roentgenograms if one is to differentiate osteoma from the clouding produced by a sinusitis. My preoperative diagnosis was a chronic suppuration of the frontal and ethmoid sinuses, which was proved at operation, but I was greatly surprised to encounter a tumor of ivory hardness in the upper portion of the septum. I must



Osteoma of the nasal septum.

confess that on a second examination of the roentgenograms I noted a definite shadow which corresponded to what proved to be an osteoma. From the junction of the lower and middle third of the septum to the cribriform plate there was a gradual widening into a dense shadow which extended well to the right, pressing on the medial orbital wall.

REPORT OF A CASE

A woman, aged 35, came to me complaining of a severe headache over the right frontal region, with swelling about the right eye. These symptoms had gradually increased over a period of six months, during which time there had been a general decline in health and loss of weight. Three years previously the patient had had a bilateral radical operation on the antrum and ethmoid.

The right eye appeared to be displaced laterally and slightly downward, with some limitation of motion to the left, probably due to swelling. The vision and eyegrounds were normal.

Heavy mucopus was evident in the ethmoid region on both sides, with heavy granulation tissue. The right anterior ethmoid region was filled with what I thought was a firm fibrous mass, covered with soft tissue, following a previous operation. Later, however, this mass proved to be bone.

The Wassermann reaction was negative and the general reflexes normal.

The roentgenograms showed a general clouding of all the sinuses and some thickening of the upper portion of the septum.

I advised a submucus resection of the nasal septum, hoping to gain thereby sufficient room to enter the right frontal sinus, for drainage and relief of the headache. To my surprise, after removing some cartilage I could not cut the bony septum with any septum forceps in my possession. With a curved Killian chisel I slowly chipped away the hardest bone that I had ever encountered. Considerable time was consumed, and as I approached the cribriform plate I decided that it would be safer to remove the remainder of the tumor by an extranasal route.

One month later, by a right lateral rhinotomy the medial wall of the orbit and the floor of the right frontal sinus were removed. The frontal sinus was large and filled with pus, and the pulsations of the brain could be seen over a large area, the posterior wall of the sinus having competely necrosed.

The dura was covered with granulations, and the anterior third of the right cribriform plate had been absorbed. The osteoma was broken away, and with it came the remaining upper part of the bone of the nasal septum.

A packing of iodoform gauze was placed in the frontal sinus and extended into the nose. The external wound was closed. The packing was partially removed on the second day after operation and completely removed on the fifth day.

The relief from excruciating headaches was immediate.

Two months later an external operation was performed on the left frontal sinus, which was found to be filled with pus but without necrosis of the posterior wall.

COMMENT

Osteomas of the nose usually occur in the ethmo-orbital region, and although they are benign tumors they are often malignant in their effect on surrounding structures. An osteoma of the nasal septum is rare, and the possibility of its producing grave complications is evidenced by the epidural abscess described.

556 Doctors Building.

RADICAL OPERATION ON THE FRONTAL SINUS UNDER LOCAL ANESTHESIA *

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AND
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In a recent publication [1] a satisfactory technic for performing radical operations on the maxillary sinus under local anesthesia was described. It has been our custom to do practically all of our radical operations on the sinus by blocking the nerves with infiltration anesthesia, and experience has proved that operation on the frontal as well as on maxillary sinuses can be performed with this method of anesthesia.

It is a simple procedure to produce satisfactory narcosis for operation on the frontal sinus, which actually requires injection at only two sites. However, since it is distinctly advantageous to inject a solution of epinephrine into the region of the primary incision, we take advantage of this infiltration by using a weak solution of procaine hydrochloride as a carrier for the epinephrine. If this step is included, it constitutes a third and optional site of anesthetization.

INJECTION INTO THE SUPRA-ORBITAL NERVE (STEP 1)

The supra-orbital foramen transmits the supra-orbital nerve which supplies the structures overlying the frontal sinus. The foramen is located at the free border of the upper rim of the orbit just medial to the midpoint of the supra-orbital ridge. It is located by palpation; the hypodermic needle is inserted, and from 0.25 to 0.5 cc. of the anesthetizing solution is injected. To enter the foramen the needle is pointed upward and backward, as indicated in figure 1.

LOCAL INFILTRATION OVER PRIMARY INCISION (STEP 2)

Beginning at the middle of the superciliary arch, the needle is inserted into the soft tissues down to the pericranium. A small quantity of procaine hydrochloride is injected. The needle is then directed laterally parallel to the line of the eyebrow and gradually carried outward superficial to the pericranium as far as the outer limits of the

* Submitted for publication, Dec. 13, 1930.

1. Ersner, M. S.; Pressman, J. J., and Ersner, W.: Local Anesthesia for the Radical Maxillary Operation: An Improved Technic of Administration, Arch. Otolaryng. **13**:379 (March) 1931.

orbit. As the needle is thus carried outward the solution is injected, infiltrating the lateral half of the supra-orbital region. The needle is then almost but not entirely withdrawn and redirected medially as far as the midline, and the solution is injected as the needle is carried toward the inner margin of the orbit. It is again partially withdrawn and redirected at right angles to the previous line of injection and carried upward for a distance of about 1 inch (2.5 cm.), and a small quantity of the mixture of epinephrine and procaine hydrochloride is injected. About 5 cc. of fluid is used in this step.

COCAINE AND EPINEPHRINE PACK IN THE MIDDLE MEATUS (STEP 3)

In the middle meatus are found the anterior and posterior ethmoidal nerves, the nasociliary nerves and the branches from the sphenopalatine

Fig. 1.—Step 1. Injection of the supraorbital nerve.

ganglion. It is essential to block these fibers because of the manipulations required to enlarge the nasofrontal duct which opens into the middle meatus as well as to anesthetize the interior of the frontal sinus itself. The middle meatus, especially in cases of long standing, is often the seat of pathologic changes which make dissemination of an injected solution insufficient to anesthetize the entire area, and for this reason we find it advantageous to supplant or supplement an injection of procaine hydrochloride with a pack saturated with a solution of equal parts of 1:1,000 epinephrine and a 10 per cent solution of cocaine. A doubled segment of bandage ½ inch (12 mm.) in width makes an excellent material for packing. Under direct vision with the nasal speculum the pack is inserted into the middle meatus from its most anterior point well back to its posterior limits (fig. 2). This pack is allowed to remain in situ until just before the nasofrontal duct is rasped.

INJECTION INTO MIDDLE MEATUS (STEP 4)

In some instances it is advantageous to supplement the packing of the middle meatus with cocaine with an injection of procaine hydrochloride. When marked polypoid or degenerative changes have taken place in the mucous membrane, the absorptive power of the tissue is in

Fig. 2.—Step 2. Anesthetizing the middle meatus with a pack of cocaine and epinephrine.

Fig. 3.—Step 3. Injection into the middle meatus.

all probability considerably lessened, so that the cocaine does not penetrate sufficiently to anesthetize the deeper structures within the middle meatus. Experience has proved that either cocaine packing alone or the injection of procaine hydrochloride alone is often insufficient, whereas a combination of the two results in perfect narcosis of the area under consideration. The injection is made prior to the insertion of the

pack. With a tonsil needle and syringe, about 0.5 cc. of a 2 per cent solution of procaine hydrochloride is injected into the middle meatus as high up under the middle turbinate as possible and about as far posteriorly as the level of the bulla cell (fig. 3). The exact site of the injection is not especially important, and the introduction of the needle anywhere in this general area will give equally satisfactory results.

Immediately following the insertion of the packing into the middle meatus, the operation is begun. It is to be noted that at no time is it necessary to cocainize the interior of the sinus. For the injection of procaine hydrochloride, except in the middle meatus, we use Cook's dental syringe and needle and a Cook carpule that contains essentially 2 per cent of procaine hydrochloride and appropriate amounts of a solution of epinephrine. If an ordinary long hypodermic needle and syringe is used, we recommend the use of a 2 per cent solution of procaine hydrochloride to which is added 20 drops of epinephrine to the ounce.

In our experience, which consists of five bilateral operations on the frontal sinus and eleven unilateral operations (Lathrop) performed on men and women, we have found this method of anesthetization to be ideal. In bilateral operations on the frontal sinus (in which cases the anesthetization is carried out on both sides in the manner previously described for one) patients have practically not complained of pain, even though the procedure is prolonged and often tiresome. There is, of course, some unpleasant sensation concerned with the sound of chiseling, and of this patients may complain, but the procedure itself is not painful. Proper preliminary preparation can do much to prevent undue discomfort from these manipulations.

Preliminary preparation consists in the hypodermic administration of $\frac{1}{100}$ grain (0.6 mg.) of scopolamine and $\frac{1}{4}$ grain (16 mg.) of morphine one hour previous to the beginning of the operation. In dealing with high-strung patients, the dose of morphine may be repeated.

This communication is intended to stress the fact that in almost every instance the radical operation on the frontal sinus can be successfully carried out under local anesthesia. Despite its obvious advantages, the method of local anesthetization is rarely used. Our experience indicates that it is the method of choice, even though many standard textbooks omit a description of the technic and recommend that the operation be performed under general narcosis. We cannot concur in this recommendation, as we have found local anesthetization the more satisfactory procedure.

PARANASAL SINUSITIS

LOCAL IMMUNIZATION TREATMENT *

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Owing to the complicated anatomic structure and individual anomalies of the paranasal sinuses in relation to size, shape and location, the treatment for chronic sinusitis is frequently disappointing in spite of surgical drainage and topical applications.

In this connection, a rather large and controversial literature has accumulated on vaccine therapy for infections of the ear, nose, throat and paranasal sinuses, although the results have generally been unsatisfactory. Some investigators have reported encouraging results, while those of others have been unfavorable, so that the exact status of vaccine therapy for sinusitis is still unsettled. Doubtless, important factors in failure have been inadequate drainage and the too widespread use of stock vaccines or the use of poorly prepared autogenous ones with failure to secure in cultures the important organisms producing the infection.

Any new method of vaccine therapy offering hope of improving the results is therefore a matter of clinical importance. In this connection, Besredka's [1] method of local immunization by the direct application of "antivirus" to the infected tissues commands considerable interest, and, at the suggestion of Professor Kolmer, I have applied it in a series of cases of chronic sinusitis.

The principle of this method of immunization is based on the assumption that the local or topical application of vaccines or "antivirus" will cause the local production of antibodies or in some manner enhance immunologic resistance and processes with better therapeutic results than follow subcutaneous injections of vaccine at a distant location.

As was expected, this new and interesting theory of the local immunization of tissue has aroused considerable interest, especially in

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* From the Laboratories of the Graduate Hospital of the University of Pennsylvania, Prof. John A. Kolmer, Director. Contributed under the Diagnostic Hospital Endowment.

* Thesis (Part II of thesis work) submitted to the Faculty of Otolaryngology of the Graduate School of Medicine of the University of Pennsylvania in partial fulfilment of the requirements for the degree of Doctor of Medical Science (D. Sc. [Med.]) for graduate work in otolaryngology.

1. Besredka, A.: Immunité général par l'immunisation locale, Ann. d. l'Inst. Pasteur **36**:522, 1922; Pansements specifiques: Étude sur l'immunité locale, ibid. **38**:565, 1924.

relation to the mechanism involved. Thus, some investigators have ascribed the therapeutic effects to the production of opsonins, while others state that various other humoral antibodies are produced. Others have expressed the belief that the toxins or other antigenic substances in "antivirus" have a particular affinity for the cells of the skin and mucous membranes, thereby resulting in an increased production of antibodies by local application.

In the field of otolaryngology, few attempts have been made with this method of treatment. Besredka,[1] Cuntz [2] and Ommyôji [3] reported its use in the treatment for otitis media; Hemeleer [4] for otofurunculosis; Lehndorff and Brumlik [5] and Carco [6] for ozena, and Singer and Spitzer [7] for dacryocystitis, but I have not been able to locate any references to the treatment for paranasal sinusitis.

METHOD EMPLOYED

In this series, ten patients with chronic paranasal sinusitis and one with ozena were treated.

Since there is doubt concerning the comparative value of local immunization with ordinary vaccines versus "antivirus," six patients were treated with autogenous vaccines by local application and five by local applications of "antivirus."

All vaccines and "antiviruses" were autogenous. The former were heat-killed and prepared in the usual manner, containing approximately 100,000,000 organisms per cubic centimeter.

The "antiviruses" were prepared according to Besredka's method and heated at 65 C. for an hour.

The vaccines and "antiviruses" were applied locally to the sinuses by the displacement method of Proetz,[8] which is employed for the roentgenographic diagnosis of sinusitis by injections of iodized oil. This method of application, however, was not entirely satisfactory, owing to obstruction by hypertrophied turbinates, nasal polypi and closed ostia, which are generally associated with

2. Cuntz, W.: Behandlung eines Falles von chronischer Mittelohreiterung mit einer vom Institut für experimentelle Therapie "Emil von Behring" in Marburg-Lahn hergestellten Yatren-Autovaccine, Fortschr. d. Therap. **4**:694, 1928.

3. Ommyôji, M.: Therapeutic Value of Antivirus in Otitis Media, and Local Immunization in the Middle Ear by Antivirus: Experimental Critics on the Special Characteristics of Antivirus, Dai Nippon Jibiinkôka-Kai Kaihô **35**:533, 1929.

4. Hemeleer, H. M.: Vaccine Therapy of Ear Affections, Arch. méd. belges **79**:250, 1926.

5. Lehndorff, H., and Brumlik, M.: Studien über das Antivirus, Wien. klin. Wchnschr. **40**:483, 1927.

6. Carco, P.: I miei risultati con la comune autovaccinotherapie mista nell'ozena, Boll. d. Soc. ital. di biol. sper. **3**:595, 1928.

7. Singer, J., and Spitzer, P.: Die Behandlung der Dacryocystitis chronica mit dem Antivirus nach Besredka, Wien. klin. Wchnschr. **40**:1576, 1927.

8. Proetz, A.: Displacement Irrigation of Nasal Sinuses, Arch. Otolaryng. **4**:1 (July) 1926; Further Data on the Displacement Method in Sinuses, Ann. Otol., Rhin. & Laryng. **36**:297, 1927.

chronic paranasal sinusitis. In the cases in which the patients were treated with "antivirus," such obstacles to the free access of the vaccines and "antivirus" to the infected tissues were first removed by middle turbinectomy or polypotomy.

Since local immunization of the nasal mucosa appears to be equally important, the vaccines and "antiviruses" were first instilled into the nasal cavity before being bubbled with a suction apparatus to displace the air in the sinuses. Cotton tampons saturated with vaccines and "antiviruses" were frequently placed in the nose for about twenty minutes. Cocaine was not employed because of the possibility of inhibiting the immunologic activities of the cells of the mucosa. However, small amounts of 2 per cent ephedrine in saline solution were sprayed into the nose before treatments were given in order to facilitate the access of the vaccines and "antiviruses" to the infected sinuses. Each patient was given two or three treatments a week for several months.

Clinical examinations were made at frequent intervals along with roentgenographic examinations, with and without the aid of iodized oil.

The opsonic index of the blood of each patient was also determined each week according to methods described by Kolmer,[9] in order to determine more particularly whether or not local immunization was accompanied by a detectable increase of the opsonins or bacteriotropines in the blood. There has been a difference of opinion among investigators concerning this question, as previously stated, although it is granted that local immunization may engender the production of sessile antibodies in or on the cells of the mucosa of the nose or sinuses without a demonstrable increase of antibodies in the blood.

RESULTS

As previously stated, ten patients with paranasal sinusitis and one with ozena without sinusitis have been treated. Six of them (cases from 1 to 6) were given vaccines by local application, and the balance (cases from 7 to 10) were given "antiviruses." Seven cases showed chronic ethmoiditis, and four showed maxillary sinusitis of several years' duration with complications of nasal polypi, hypertrophied turbinates or other pathologic changes. Two (cases 1 and 7) of the seven cases of ethmoiditis were associated with hypertrophic rhinitis, two (cases 1 and 2) with nasal polypi, one (case 5) with atrophic rhinitis, one (case 11) with tuberculous dacryocystitis (right side) and one (case 8) with maxillary sinusitis. One (case 4) of the four maxillary cases was post-traumatic, one (case 6) was subacute, one (case 8) was of a chronic type complicated by ethmoiditis and one (case 11) was associated with fetid atrophic rhinitis (the bacillus of Perez was not found). The only case (case 9) without evidences of paranasal sinusitis (all clinical and roentgenographic examinations gave negative results) was one of ozena (the bacillus of Perez was found).

Bacteriologically, the majority of these patients were infected with *Staphylococcus albus* and *S. aureus*. *Staphylococcus albus* was present in seven cases and *Staphylococcus aureus* in four, including one (case

9. Kolmer, J. A.: Infection, Immunity and Biological Therapy, ed. 3, Philadelphia, W. B. Saunders Company, 1923.

7) in which both organisms were found and one (case 10) in which the organisms were associated with *Streptococcus hemolyticus*. The bacillus of Perez was present in one (case 9) of the two cases of fetid atrophic rhinitis. In some of these cases there were associated organisms of the nonpathogenic type. The vaccines and "antiviruses" were made only of pathogenic organisms.

Clinical observations demonstrated no unfavorable effects or untoward reactions from local applications of vaccines or "antiviruses." Many of the patients treated had stubborn chronic infections of many years' duration for which ordinary treatment had been tried practically without results.

TABLE 1.—*Observations in the Eleven Cases Studied*

Case	Age	Diagnosis	Bacteriology	Results
1	35	Ethmoiditis chronica; rhinitis catarrhalis	Staphylococcus albus	Improved
2	59	Ethmoiditis chronica et myxoedema	Staphylococcus aureus	Improved
3	35	Ethmoiditis chronica; rhinitis hypertrophica	Staphylococcus aureus	Not improved
4	30	Sinuitis maxillaris	Staphylococcus albus	Improved
5	15	Ethmoiditis chronica; rhinitis atrophica	Staphylococcus albus	Not improved
6	14	Sinuitis maxillaris	Staphylococcus albus	Improved
7	65	Ethmoiditis chronica; rhinitis hypertrophica	Staphylococcus aureus et albus	Improved
8	21	Sinuitis maxillaris; ethmoiditis chronica	Staphylococcus albus	Recovered
9	38	Rhinitis atrophica foetida (ozena)	Bacillus of Perez	Improved
10	11	Sinuitis maxillaris chronica; rhinitis atrophica foetida	Streptococcus; Staphylococcus aureus	Not improved
11	25	Ethmoiditis chronica; dacryocystitis tuberculosa	Staphylococcus albus	Not improved

Local immunization, however, resulted in improvement in seven cases, including one of apparent recovery (table 1). The remaining four did not show improvement, but they did not present further evidences of progression of the infection.

Three of the four cases were cases of chronic ethmoiditis, one associated with atrophic rhinitis (case 5), one with tuberculous dacryocystitis (case 11) and one (case 10) with atrophic rhinitis.

Of the seven cases showing improvement, four were cases of ethmoiditis (cases 1, 2, 7 and 8), three of maxillary sinusitis (cases 4, 6 and 8) and one of ozena (case 9). In two of these cases (cases 1 and 2) polypi were removed, and in a case of maxillary sinusitis associated with ethmoiditis a radical operation was performed on the left antrum with submucous resection.

Four of the six patients treated with local applications of autogenous vaccines improved and two did not. One of the five patients treated with "antivirus" recovered, two improved and two did not show improvement.

However, the results do not permit one to draw conclusions concerning the comparative merits of local applications and of vaccines and "antiviruses." Both methods yielded encouraging results in some cases, although since local applications of "antivirus" gave particularly good results in one case of chronic sinusitis and in one of ozena, it would appear that the local application of this substance was somewhat more effective than local applications of autogenous vaccines.

While opsonic determinations at weekly intervals were laborious and time-consuming, they yielded but little definite information after allowances were made for normal fluctuations and experimental error (table 2). Certainly they did not prove of practical value in gaging the

TABLE 2.—*Opsonic Determinations*

	Opsonic Indexes at Weekly Intervals*													
Case	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.....	0.6	1.8	0.8	0.7	1.7	1.0	1.2 (p)	...	1.4	0.9	1.1	0.8	1.0	...
2.....	1.3	0.6	0.6	1.1	0.6	0.7	1.0	(p)	0.6 (p)	...	0 8	1.0	1.1	...
3.....	1.1	...	0.6	0.9	1.3	...	1.1	1.2	1.6	...	1.2	...	1.0	0.8
4.....	1.8	...	1.2	1.3	...	1.8	...	1.7	0.8	1.0	0.9	1.1	1.6	1.3
5.....	1.1	0.7	1.2	1.4	1.0	0.8	...	0.4	...	0.6	...	0.8	...	...
6.....	0.8	...	1.0	...	1.3	1.0	1.2	...	...	...	...	...	...	...
7.....	0.8	1.1	1.3	1.1	0.6	0.9	0.7	1.1	0.6	...	1.4	0.9	0.8	1.2
8.....	0.7	0.8	1.2	0.8	(d)	1.3	1.0	0.7	1.2	0.8	0.9	1.1 (e)	0.9	1.0
9.....	1.3	0.9	0.6	1.0	0.7	1.2	0.8	0.9	1.1	...	1.0	...	1.1	...
10.....	1.1	0.9	0.8	...	1.2	1.1	0.6	1.3	...	0.9	0.8	1.2	...	0.6
11.....	1.8	1.0	0.5	...	0.5	1.5	(t)	1.4	1.1	0.7	1.3	1.7	0.9	...

* p indicates polypotomy; d, deviatectomy; e, operation on the antrum; t, tonsillectomy.

frequency and results of treatment. In a general manner, however, it would appear that the patients treated with "antiviruses" showed a somewhat greater production of opsonin than those receiving local applications of autogenous vaccines, confirming the clinical impression that local applications of "antiviruses" are somewhat more effective than applications of the latter. Indeed, the indexes were influenced more by the general condition of the patients and by operations than by the local applications.

CONCLUSIONS

1. Ten patients with chronic paranasal sinusitis and one with ozena were treated from two to three times a week for several months with local applications of autogenous vaccines and "antiviruses" (Besredka).

2. Seven patients showed improvement, with one apparent recovery, and four did not show improvement.

3. The results of treatment with vaccines and "antiviruses" were closely similar, although local applications of the latter were apparently somewhat more effective in some cases.

4. Local applications of vaccines and "antiviruses" to the nasal mucosa and paranasal sinuses were well borne, without untoward effects or reactions.

5. Opsonic indexes at weekly intervals were of no clinical value and were apparently influenced in greater degree by the general condition of the patients and operative procedures than by local applications of vaccines and "antiviruses."

6. In general terms, it may be stated that the treatment for paranasal sinusitis and ozena with local applications of autogenous vaccines or "antiviruses" by the displacement method of Proetz may constitute a means of improving present methods of treatment.

THE PROBLEMS OF DEAFNESS*

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I have chosen to discuss this subject particularly because there is a general lack of appreciation of its importance. The magnitude of the problem is difficult to estimate, for those afflicted with deafness tend to conceal their defect. No one knows the extent of the world of silence. There are available, however, some statistics that give an idea of the extent to which defects in hearing affect the population.

The United States census for 1920 lists approximately 45,000 deaf-mutes. This figure includes only those who acquired severe deafness before the age of 8 years, since children who lose their hearing after this age do not, as a rule, lose the ability to speak which they have already acquired, and are, therefore, not deaf-mutes. The list of deaf-mutes includes those who have been born deaf and those who acquire their defect before the age of 8 years. There are no accurate figures showing the really large number of children over the age of 8, and of adults, who suffer from severe deafness, or the still larger number who are afflicted with moderate defects of hearing. Examinations of school children indicate that approximately 10 per cent suffer from some defect of hearing. It has been estimated that there are approximately 3,000,000 children in the United States with subnormal hearing and over 10,000,000 persons with some defect in hearing. These figures may serve to give some idea of the extent of the world of deafness. My purpose is to present some of the outstanding problems associated with the loss of hearing.

THE MECHANISM OF HEARING

Two conditions are necessary for normal hearing. In the first place, there must be a mechanism for collecting the sound impulses that originate in the outer air and for their conduction into the head, where they are brought in contact with the terminal filaments of the nerve of hearing. In the second place, there must be a mechanism for transforming these physical sound waves into nerve impulses, an end-organ of hearing, and for conducting these nerve impulses to the centers in the cortex of the brain where the actual perception of sound takes place.

Defects in hearing that are produced by alterations in the first of these mechanisms are called obstruction or conduction deafness; and defects that are the result of impairment in the nervous mechanism are

* Submitted for publication, Jan. 5, 1931.

* President's address, read at the Annual Meeting of the Chicago Institute of Medicine, Dec. 2, 1930.

named nerve deafness, or perception deafness. Alterations in the sound-conduction mechanism are capable of producing only a moderate defect in hearing. All conditions of severe deafness, therefore, including a total loss of hearing, must be produced by alterations in the nervous mechanism. It is apparent that the location of the alteration which produces a defect in hearing can often be determined from the degree of deafness.

CONGENITAL DEAFNESS

Defects in hearing are either congenital or acquired. Congenital defects result from developmental anomalies that may involve the conduction mechanism by producing atresia of the external canal, or the perceptive mechanism by defects in the internal ear. These developmental anomalies rarely involve simultaneously the external and inner ear. A child born with an absence of the auricle or with atresia of the external canal suffers only a moderate defect in hearing, even when the anomaly is bilateral, since the labyrinth usually remains quite normal. These children usually present no serious problem so far as the hearing is concerned. Surgical efforts to establish a patulent external canal have, therefore, no particular justification. The situation is different when the developmental anomaly involves the internal ear, for this may produce profound deafness or a total absence of hearing.

It is interesting to note the extent to which congenital deafness is the cause of deaf-mutism. In an extensive survey of the children in public institutions for the deaf, undertaken under the auspices of the National Research Council, the report of which has just been published,[1] we found that of the 5,348 children examined, 3,334, that is, three-fifths, were congenitally deaf. In the etiology of congenital deafness, heredity and consanguinity play a conspicuous rôle. Of the 3,334 congenitally deaf children, heredity or consanguinity was a factor in 1,374, that is, more than one-third. In 232 instances, consanguinity was present. There were 112 instances of marriage between first cousins; 64 instances of marriage between second cousins; 36 between third cousins and other relationships less frequent. Deafness in the families of these children was as follows: parents born deaf (one or both), 144; aunts deaf, 126; uncles deaf, 112; cousins, 175; grandparents, 40, and other relatives, 59. Of the 3,334 congenitally deaf children, only 144 were born of deaf parents. The statistics, when more than 1 child in the same family was born deaf, are of special interest. In 484 instances, 1 other child in the same family was born deaf; in 211 instances, 2 other children; in 47, 3 other children; in 13, 4 others, and in 6, 5 other children

1. Shambaugh, G. E.; Hayden, D. B.; Hagens, E. W., and Watkins, R. W.: Statistical Studies of the Children in the Public Schools for the Deaf: Additional Report of Committee, Division of Medical Sciences, National Research Council, Arch. Otolaryng. **12**:190 (Aug.) 1930.

in the same family were born deaf. Seventeen pairs of twins were born deaf. It is obvious that the important step in the prevention of congenital deafness is to discourage consanguinity, as well as the bearing of children, by those with a family history of congenital deafness.

An interesting fact brought out by the examination of this group of congenitally deaf is that in 1,261 of 3,334 children total deafness was found, while vestiges of hearing were detected in 2,069; in 4 children no adequate tests of hearing were made. The children examined in the public institutions for the deaf include only those with profound deafness. There is no way of knowing how many others there may be who are afflicted with congenital deafness producing only moderate defects in hearing. The latter may, of course, also give birth to deaf children.

ACQUIRED DEAFNESS

Acquired deafness presents much more formidable problems than does congenital deafness. In public institutions for the deaf, less than half of the children suffer from acquired deafness. Of the 5,348 children whom we examined, there were 2,014 whose deafness was acquired. Obviously, this figure does not begin to tell the whole story of acquired deafness, since it includes only children with profound defects. To this list must be added children with moderate deafness, that is, in whom the defect is not severe enough to necessitate their being cared for in institutions for the deaf. Approximately 10 per cent of the school children have some defect in hearing, and perhaps 3,000,000 children in the population are more or less handicapped by moderate deafness.

Even this figure does not begin to show the magnitude of the problem of deafness. Most persons who are afflicted with severe deafness acquire this defect from a process that begins in adult life and has nothing to do with the aural troubles of childhood. No one knows the extent to which defective hearing affects the adult population. In the examination of 2,750,000 men for the draft during the World War, 39,000 were found with an aural defect. Most of these were rejected because of disability.

Every period of life—childhood, middle life and old age—has its peculiar type of aural troubles which menace the hearing. In childhood, it is the tubotympanic process that affects the hearing by producing rigidity in the sound-conducting mechanism. In adult life, it is the process known as chronic progressive deafness, a condition which from its onset leads gradually to bony ankylosis of the stapes. Later in life, there begins an equally insidious process which produces degeneration of the nerve of hearing and which is commonly called senile deafness. Each of these three types of aural trouble usually develops independently. The tubotympanic processes of childhood neither predispose to, nor prevent, the development of otosclerosis in adult life. Primary

degeneration of the eighth nerve in people past middle life often develops independent of any previous aural trouble, that is, either tubotympanic disease or otosclerosis. There is, of course, nothing to prevent all three of these processes from developing in the same person. For example, a child in an otosclerotic family may, as the result of adenoids, develop a tubotympanic process which may or may not leave some permanent disturbance of hearing. When the child reaches adult life, the latent hereditary tendency for otosclerosis may become active and produce fixation of the stapes, and as the years pass senile degeneration of the nerve may take place. As a matter of fact, a permanent depression in the function of hearing, left as the result of an adhesive process in the middle ear which may have become inactive, usually leads to a secondary degeneration of the nerve of hearing; and deafness, the result of fixation of the stapes in otosclerosis, is also associated, sooner or later, with degeneration of the eighth nerve.

Childhood is rightly regarded as the most precarious period in life so far as the ears are concerned. Early childhood is the danger period for the development of those profound defects of hearing that result in deaf-mutism and that necessitate the child's being placed in an institution for the deaf. Our statistics showing the age at which deafness in children was acquired reveal the fact that 61.7 per cent became deaf by the third year of life; by the fifth year, 78.8 per cent had become deaf. In only 10.4 per cent did deafness develop between the ages of 5 and 10.

It is during the preschool years that the child's health should be particularly safeguarded. The belief still prevalent among many mothers that the young child should be exposed to the infectious fevers of childhood, for example to measles, in order to get it over with, is a serious mistake. An older child is better able to fight off the infection, while the younger child, purposely exposed to the infection, may become stone deaf as a result.

The aural disease most prevalent in childhood, the tubotympanic processes, rarely results in a serious permanent disturbance in the function of hearing. On the other hand, the condition that produces those profound defects in hearing which handicap so many people in adult life is the process of otosclerosis, which is rarely recognized before the age of puberty, and which usually becomes manifest during the second decade.

ETIOLOGY OF ACQUIRED DEAFNESS

The examination of children in public institutions for the deaf brought out many interesting facts, only a few of which I shall attempt to discuss. The question of etiology is of primary interest. What caused the disturbances of hearing in these children with profound acquired deafness? We were required to rely on the records kept in these institutions for data regarding etiology, and the information obtained

in this way must be carefully scrutinized, for obviously only some of the data can be accepted as some are palpably erroneous. For example, when the records show that a child suffered from meningitis, measles or scarlet fever, there can scarcely be any room for doubt that this was actually the cause. Our statistics gave a fall as the cause of deafness in seventy children, fracture of the skull in thirty, and accident in four. Obviously, these figures must be subjected to a wide margin of reservation. When fracture of the skull is given as the cause, we are inclined to accept this as probably correct. A fracture of the skull is a recognized cause for the destruction of hearing, and its diagnosis can usually be made by the family physician. On the other hand, when a fall or accident is given as the cause of the loss of hearing, this etiology cannot be accepted at its face value. In the first place, the only sort of fall or accident that can produce destruction of the hearing is one that results in fracture of the skull, and when this had actually taken place it is probable that it would have been recognized and properly designated in the record. In the second place, one must remember that the defect in a congenitally deaf child is often not recognized before the child is 2 or 3 years of age, and that parents are usually anxious to discover some acquired cause to explain the deafness, while they are reluctant to accept the idea that they have given birth to a defective child. Every child has many falls and accidents which parents may accept as the cause of the deafness rather than the fact that the child had actually been born deaf.

In the etiology of acquired deafness in these children, meningitis leads the list with 385 cases. To this number should be added 26 children who are listed as having lost their hearing due to "brain fever," which brings the total to over 20 per cent. Measles is second on the list, having caused 8.5 per cent of the cases of deafness; scarlet fever and influenza are third, each having caused approximately 7 per cent.

Hereditary syphilis has been suspected by some as a common cause for severe deafness in childhood. In one of the public institutions for the deaf 400 children were examined for the Wassermann reaction of the blood. In this school the cases were approximately equally divided between the congenital and the acquired type of deafness. The results showed only 2 children with a positive Wassermann reaction. This result coincides with the information we gathered from other schools; namely, that syphilis does not appear to be an important factor in the etiology of severe deafness in children.

PATHOLOGY OF ACQUIRED DEAFNESS

What is the nature of the pathologic changes in the ear that are responsible for the profound deafness in children with acquired defects? One fact stands out sharply defined: only an involvement of the nervous mechanism in the internal ear can be responsible for these profound

disturbances of hearing. Alterations in the middle ear affecting the conduction of sound are capable of producing only moderate defects of hearing. There are two processes that may invade the labyrinth in infectious fevers, either of which may destroy the hearing. One is an extension of an infection from the middle ear or the meninges into the labyrinth, producing a destructive suppurative labyrinthitis; this occurs in most cases of meningitis. The other process responsible for the destruction of the hearing in the infectious fevers is the development of a degenerative neuritis of the nerve of hearing. Our study of these children demonstrated that both in measles and in scarlet fever, neuritis of the eighth nerve was usually responsible for the deafness. For example, in 121 of the 172 children found deafened from measles, deafness developed without an associated otitis media. In the remaining 51 children in whom there was an otitis media, it became clear that it was usually through a toxic neuritis and not because of an extension of the suppuration from the middle ear to the labyrinth that the hearing had been destroyed. The reason for this conclusion is that when a suppurative labyrinthitis occurs, all vestiges of function are destroyed. Total deafness was found in but 14 of these children, while vestiges of hearing could be demonstrated in 37.

Similar observations were made in connection with scarlet fever. Of the 139 children deafened through scarlet fever, deafness without an associated otitis media had developed in 81. Of the 58 in whom there was an associated otitis media, the deafness was total in only 24; that is, there were but 24 children in whom suppurative labyrinthitis might have occurred. The fact that a total destruction of function had occurred in association with otitis media is no definite proof that there had been an actual invasion of the labyrinth by the suppurative process, for total destruction of function is also produced by a toxic neuritis. As a matter of fact, of the 121 children deafened through measles who had not had otitis media, that is, toxic neuritis was responsible for the deafness, total defects were found in 42. Of the 81 children deafened through neuritis of the eighth nerve caused by scarlet fever, total deafness was found in 41. It would appear, therefore, from these statistics that of the 172 children deafened as the result of measles, there were probably not more than 7 in whom the deafness should be attributed to otitis media, and of the 139 children deafened as a result of scarlet fever, there were perhaps not more than 12 in whom the deafness had been the result of disease of the middle ear.

From the facts brought out in this study of acquired deafness, it is apparent that little can be expected in the prevention of profound deafness from the infectious fevers by more prompt or better care for the otitis media which so frequently complicates both measles and scarlet

fever. The prevention of the calamity of profound deafness following the infectious fevers is to be found in the prevention, or in the prompt cure, of the disease itself.

Aside from these unfortunate children in the public institutions for the deaf afflicted with profound deafness, congenital and acquired, children with moderate defects in hearing produced by aural disease are extremely common. It has been estimated that there are at least 3,000,000 such children. The prevailing aural disease in these children is a tubotympanic process usually dependent on disease of the tonsils or adenoids, conditions that can usually be prevented or at least arrested.

PERIODIC EXAMINATIONS OF THE EARS OF SCHOOL CHILDREN

In recent years attention has repeatedly been called to the importance of conducting periodic examinations of the ears of school children. This would be a most desirable plan, and I suspect that the time is not far distant when it will be generally adopted. The examination of the ears of school children has several important practical objectives, only some of which have to do primarily with defects in hearing. Deafness in children, as in adults, tends to conceal itself, though not for the same reason. Children who are backward in their school work are often retarded because of defective hearing when the condition may not even be suspected by the instructor. Alterations in hearing among school children vary from slight defects that are scarcely appreciable to deafness so severe that segregation of such children in classes where they may receive special instruction is necessary. The first objective of the aural examination of school children should be the detection and segregation of those children who are severely handicapped. Such children are few, and with the cooperation of the teacher are readily discovered and the status of hearing best determined by simple voice tests. There is a second group of children with moderate defects who do not require segregation or special instruction but in whom, with a recognition of the situation by the instructor, the handicap may be overcome by a little special attention such as a seat in the front row in the classroom. The recognition of these cases is also most readily made by the simple voice tests which an instructor or a nurse can be taught to carry out.

The other practical objective in the aural examination of school children has to do with the detection of aural conditions requiring treatment, such as discharge from the ears and the tubotympanic catarrhal processes prevalent in childhood. To attain this objective, the service of an experienced aurist is necessary, for an otoscopic examination is essential. As a matter of fact, with proper cooperation, such examinations can be carried out quickly, one or two minutes at most being necessary for each child. The program for the examination of the ears of school children has been more or less confused in this country.

The idea has been advanced that by the detection of incipient defects of hearing in school children and their proper treatment, we shall be able to prevent the development of progressive deafness in adults. This idea has even been held the major objective in such examinations. There has also been propaganda for the introduction of tests with the audiometer for the detection and grading of slight defects of hearing. As a matter of fact, these minor defects in the hearing of school children have relatively little clinical importance. The tubotympanic processes which are responsible for these alterations in the hearing of school children are rarely prolonged into adult life as active or progressive processes, and they have, therefore, little to do with the cause of the progressive deafness of middle life. The conditions in the children which call for treatment are detected, not by testing the hearing with audiometers or by other means, but rather by an aurist using the ear speculum.

Before we can expect to see the proper establishment of the periodic aural examination of school children, the idea that we shall be able to prevent progressive deafness in adults by relieving tubal trouble in children must be corrected, and emphasis must be placed on the proper objectives in such examinations. I do not see that the practical objectives to be obtained from the examination of the ears of school children are particularly facilitated by the introduction of audiometer tests, which are always more or less cumbersome, and which serve to divert attention from what should be the practical objectives. The objectives that are tangible are most readily obtained, and the practical evaluations of tests of hearing are more readily and more accurately made by employing simple voice tests.

The suppurative diseases of the middle ear so prevalent during childhood are a menace not so much because of the defects which they produce in the hearing as because of the occurrence of serious intracranial complications. As a matter of fact, the real menace to hearing is present in those cases in which the more serious complications threaten the life of the patient. The prevention or the prompt cure of suppurative otitis media would mean the prevention of the severe deafness which results from an extension of the suppuration from the middle ear to the labyrinth.

OTOSCLEROSIS

Chronic progressive deafness of adult life is the most serious problem that confronts the otologist. The condition is improperly called otosclerosis, a term that has become fixed in our vocabulary. The expression otosclerosis helps to perpetuate in the minds of many an early mistake whereby under the name of chronic dry catarrh of the middle ear the process of progressive deafness was confused with the

tubotympanic processes so common in childhood. As a matter of fact, chronic, dry catarrh of the middle ear does not exist, with the exception of the occasional persistence in the middle ear of a residue from an exhausted tubotympanic process of childhood, and this condition is progressive only in that it may occasionally become the seat of an acute exacerbation from some fresh infection in the nasopharynx.

Otosclerosis is a condition that rarely begins before the second decade. It is the process that is responsible for most of the cases of severe deafness that handicap so many people in middle life. In a study made from my office records,[2] I found that one of every three patients who consulted me on account of aural symptoms was the victim of otosclerosis. There is no evidence that this condition results from the tubotympanic conditions of childhood, nor does it depend on conditions of the nose and throat. Heredity plays a conspicuous rôle in its etiology. The pathologic changes are primarily in the bony capsule of the labyrinth, and produce gradual bony fixation of the stapes with all the characteristics of obstructive deafness. With this condition is associated degeneration of the eighth nerve, which appears sometimes earlier, sometimes later, and in the more progressive cases eventually leads to profound deafness, even total loss of hearing.

The problems presented by otosclerosis are most perplexing. Except for the strong hereditary factor, it is not known what is responsible for the bony changes. It is suspected that there may be some general pathologic condition, possibly a disturbance of the endocrine glands, and the correction of this condition may help to prevent or possibly control the progress of the otosclerosis. So far, there are only speculations, and the problem of the etiology of otosclerosis is as far from the solution today as when the condition was first recognized. The one practical proposal for the prevention of the disease is discouraging the bearing of children by those with a family history of otosclerosis.

Those who are afflicted with progressive deafness in middle life readily become the victims of all sorts of misdirected treatments, especially of treatments directed toward the nose and throat, by those who are confusing otosclerosis with the tubotympanic processes of childhood. Since the latter can often be corrected by the removal of diseased tonsils and adenoids, it is only natural that when otosclerosis is confused with these tubotympanic processes the cause would be suspected to lie in the nose. The result is that all sorts of tinkering operations are proposed for the correction of anatomic irregularities in the nose that exist almost universally, with the object of arresting the progress of the deafness. It is but natural, too, that those hopelessly deafened should often submit to such proposed treatments rather than accept the opinion of

2. Shambaugh, G. E., and Holderman, J. W.: The Occurrence of Otosclerosis in the Etiology of Progressive Deafness, Arch. Otolaryng. **4**:127 (Aug.) 1926.

those who appreciate the entire futility of such work. I suspect that there is no class of patients who are more often the victims of quackery than are those who in middle life are afflicted with progressive loss of hearing. The aural quack who proposes to cure incurable deafness is found everywhere. It does not seem to matter how absurd the proposed treatments may be; all that is required to assure financial success for the quack is that he cultivate simple tricks of salesmanship. One scratches the vault of the pharynx with the finger-nail, labels the process "finger surgery," and demands a fee for the deception; another passes an attenuated x-ray current through the head of his patient and finds his office filled with hopeful victims, while another carries out bizarre treatments of the eustachian tube by the passing of bougies, albeit the tube presents no alterations in otosclerosis.

THE PROBLEMS OF READJUSTMENT

The problems of readjustment that confront the otosclerotic person are particularly difficult. When a child is the victim of acquired or congenital deafness, the adjustments, such as are possible, are accomplished without mental distress to the child; in a large measure, the same may be said concerning the loss of hearing associated with the declining faculties in old age. But when a person in middle life is confronted with progressive loss of hearing, the problems of adjustment are difficult and often distressing. A person entering the land of silence finds himself isolated, even more isolated, often, than does the victim of blindness. Efforts at rehabilitation must take this into consideration and undertake to create a new environment to replace the one that is slipping away. The economic problems may be peculiarly distressing. The handicap from progressive deafness in middle life comes at a time when the person has already made an economic adjustment suitable to one with normal hearing, but which may not be compatible with defective hearing. A complete economic readjustment is, therefore, often necessary. There are occupations in which deafness is not necessarily a handicap, but how to find out just what these occupations are and especially how, in the rushing stream of middle life, to make the proper selection are perplexing problems, for the solution of which the deafened are urgently in need of sympathetic assistance.

One of the problems of first importance for the victim of progressive deafness is the problem of bridging the ever-increasing chasm caused by the decline in hearing. What, if any, are the substitutes for hearing, and what mechanical aids are available for those who are losing their hearing? The most substantial crutch for these people to lean on is to cultivate the faculty of paying closer attention to the speaker, thereby developing the ability to piece out what is not clearly heard by interpret-

ing facial expression, that is, learning so-called lip reading. Those with normal hearing scarcely appreciate to what extent even they rely on the assistance from reading lips to interpret what cannot be readily heard. The cultivation of the ability to read lips becomes of increasing importance as the function of hearing declines, and although the facility with which one acquires the ability to read lips differs with the individual, it is the most important substitute available for those who find that they are losing their ability to hear.

Mechanical devices as aids to hearing take a second place. Any device that is conspicuous is particularly objectionable to deaf persons, who tend to be secretive about their defect and are peculiariy averse to calling attention to it by the use of conspicuous mechanical aids to hearing. Ear trumpets, speaking tubes and electrical devices are not equally useful in all cases of defective hearing. A person with nerve deafness is restricted to the use of ear trumpets, or, when the deafness is more marked, to the speaking tube. Electrical devices, because of the lowered bone conduction in nerve deafness are of no particular aid, as a rule, in this type of deafness. On the other hand, the otosclerotic person with fixation of the stapes and deafness due to obstruction in sound conduction finds considerable assistance from the use of the electrical hearing device as the deafness become more advanced. The efficiency of this device, just as the ability to hear well over the telephone, depends on the increased bone conduction always present in obstructive deafness. The most serious complaint from those who use such devices is that they magnify all sounds, so that an instrument which increases the loudness of the spoken voice to bring it up to the threshold of hearing, at the same time magnifies other sounds throughout the tone range to such an extent as to produce a great deal of confusion and annoyance. Persons who in addition to the deafness caused by fixation of the stapes producing a defect in hearing for the lower tones have developed an extensive defect for the upper tones as the result of secondary degeneration of the nerve experience less confusion from this overmagnification than do those with deafness resulting from fixation of the stapes alone and restricted, therefore, to the lower tones.

From this cursory survey of the problem of rehabilitation for those who in adult life lose their hearing, it is apparent that the problem is social rather than medical. What is needed is organized assistance to help in maintaining, or rather in reestablishing, social contacts, to give encouragement in acquiring facility in lip reading and to aid in securing suitable employment. Considerable progress has been made in this country in solving this problem. Through the efforts of Dr. Wendell Phillips, the League for the Hard of Hearing has been developed. The League maintains social centers where those with defective hearing may meet and cultivate lip reading and participate in entertainment suitable

for their condition. The League maintains employment bureaus to assist deafened persons in maintaining their economic independence.

The problems of deafness are peculiarly difficult and, therefore, present a definite challenge. These problems include the prevention of congenital and acquired serious deafness in young children, arresting of the tubotympanic diseases common in childhood, the discovery of the cause and eventually the prevention of otosclerosis, and arresting the degenerative processes that involve the nerve of hearing in advancing years. These are the medical problems that are engaging the serious attention of otologists.

We should endeavor to establish a periodic examination of the ears of school children in order to assist in the educational problems of those who are handicapped because of defects in hearing, and to be able to call attention to the aural conditions prevalent among school children which require medical attention. Finally, we need to assist in the great social problem of rehabilitation for those who are deafened in middle life.

These are some of the problems of deafness. No greater opportunity exists for human salvage among the population than that presented by those who are deafened, and there is no field that has been more neglected.

THE INTERPRETATION OF CONDUCTION DEAFNESS

REPORT OF TWO UNUSUAL CASES *

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Conduction deafness, as the term indicates, implies a disability in the apparatus for the transmission of sound and is synonymous with middle ear deafness. The amount of lowering of the acuity for hearing sounds transmitted by air conduction is necessarily dependent on the degree and the nature of the disability and attains a maximum under conditions of a complete structural or functional loss of the sound transmission system. The functional efficiency of the drum membrane and ossicular chain in the transmission of sounds by air conduction might be considered to be thoroughly established if one takes as evidence the almost universal agreement found in the published statements related to this problem. A review of the literature is unnecessary and only four abstracts will be submitted, three of which echo the consensus and one arrives at a similar conclusion in an entirely different manner.

Mangold [1] considered the physiology of the middle ear apparatus and stated that:

> The drum membrane is accordingly primarily necessary to bring about a directed transmission of sound to the oval window. Because this transmission is less important for higher frequencies, the depression in acuity due to the loss of the drum membrane and two outer ossicles, as experience has shown, is for the most part restricted to the lower tones.

Runge,[2] in the same volume (p. 415), considered the evidence from an otologic rather than from a physiologic point of view:

> The evidence for the importance of the ossicular chain in the transmission of air sounds appears to me to be still further established because we found the necessity of the ossicular chain in the transmission of at least the lower frequencies was also demonstrable for bone transmission. This evidence has been submitted in a recently published paper.

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* From the Department of Anatomy, St. Louis University School of Medicine.

1. Mangold E.: Das äussere und mittlere Ohr und ihre physiologischen Funktionen, Handbuch der normalen und pathologischen Physiologie, Berlin, Julius Springer, 1926, vol. 11, p. 429.

2. Runge, H. G.: Die pathologische Physiologie des schalleitenden Apparates, footnote 1, p. 436.

Schlittler [3] presented a concise and comprehensive statement:

> Pathologic changes in region of the apparatus for the transmission of sound as found in defects (perforations of the drum membrane) and in weighting, as for example in swelling of the mucous membrane (otitis media), disturb the labile balance of the apparatus for the transmission of sound. This is likewise the case in fixation of the drum membrane and ossicular chain including the oval window as residues of former inflammations in the form of scars and adhesions; in otosclerotic changes about both windows; and in accumulations of liquid in the middle ear (transudates and exudates, blood and liquor). All of these conditions result in a common effect which is a depression of the acuity for hearing the lower portion of the pitch range, and in a general way, the more pronounced the pathologic changes, the more marked the effect. The upper portion of the pitch range is perceived quite unchanged, because the powerful pulses (kräftigen Wellen) of the higher frequencies do not require transmission through the ossicular chain. Every day clinical experience and also the results of functional tests establish that the ossicular chain is an apparatus for the transmission of sound particularly for the lower half of the pitch range. This is also supported by the experiments of Hössli and of von Eicken. Here anatomically demonstrable lesions in the internal ear due to tones of the middle pitch range were found on the side of the intact apparatus for the transmission of sound in experimental animals but not on the other side where the continuity of the chain was interrupted by extraction of the incus.

This last statement is a slip of the pen, because neither Hössli nor von Eicken mentioned that their experiments establish an especially low frequency transmission in the ossicular chain. Similarly, the statement that higher frequencies do not require transmission through the drum membrane and ossicles because of the power in the sound pulses is misleading, because absolute sensitivity tests show that the amount of energy required to hear 2,048 double vibrations is only a minute fraction of that necessary to hear 128 double vibrations.

Even Specht,[4] who expressed the belief that the transmission of sound takes place through the round window, agreed that the drum membrane and ossicular chain are important in the perception of low frequencies, and made his theory of direct activation conform with the accepted point of view. This he accomplished by assuming a pressure against the round window and a counterpressure through the ossicular chain at the oval window. High frequencies meet with sufficient resistance in the labyrinth itself, but low frequencies require an adjustable counterpressure which is furnished automatically by the drum membrane and ossicular chain. The counterpressure function therefore rises as

3. Schlittler, E.: Klinische Methoden der Untersuchung des Gehörorgans, Handbuch der biologischen Arbeitsmethoden, Berlin, Urban & Schwarzenberg, 1926, part 7, no. 5, p. 707.

4. Specht: Zur Physiologie des Hörens, Arch. f. Ohrenh. **114**:1, 1926.

the frequency falls, and defects in the drum membrane and ossicular chain accordingly have an effect on the low frequency end of the pitch range.

As opposed to the accepted point of view that the apparatus for the transmission of sound is functionally more efficient in the lower frequency range, my observations [5] have led to the conclusion that the drum membrane and ossicular chain are of nearly equal functional efficiency throughout the pitch range. This was determined by comparing the average acuity curves for air and bone conduction of normal persons with those obtained from patients giving negative reactions to the Rinne test and having obvious fixation of the stapes but normal acuity of bone conduction. The average acuity curves for air conduction in these patients presented a normal type uniformly depressed throughout the pitch range by a factor of from 35 to 40 decibels (an intensity increase in the signal of from 3,000 to 10,000 times that of the normal threshold stimulus). This information was directly correlated with the acoustic insulation of the end-organ and with the efficiency of the apparatus for the transmission of sound.[6]

If the evidence presented shows that the drum membrane and ossicular chain are of about equal functional efficiency throughout the usual audible range, then three possibilities suggest themselves: first, that the unanimously accepted observations are not real phenomena; second, that the accepted results of functional tests on persons with conduction deafness must be interpreted on some other basis than that of a variable efficiency in the apparatus for the transmission of sound; and finally, that the evidence presented in favor of an equal functional efficiency for the apparatus for the transmission of sound throughout the usual pitch range is at fault. The third objection cannot be answered very well by the observer himself.

The first possibility stated is that of the realness or the unrealness of the observed phenomenon. It has been quite definitely established, for example, that paracousis willisi is not a real phenomenon, and that deafened people do hear conversation better in the presence of noise, because persons with normal hearing unconsciously increase the intensity of the voice under these conditions. Similarly persons with negative Rinne reactions, with no occlusion of the external auditory canal or without loading of the drum membrane, do not show increased acuity of bone conduction in spite of the fact that they hear forks

5. Pohlman, A. G.: Correlations Between the Acuity for Hearing Air and Bone Transmitted Sounds in Rinne Positive and Rinne Negative Cases, Ann. Otol. Rhin. & Laryng. **39**:927, 1930; Acoustic Insulation and the Efficiency of the Sound Transmission System, Anat. Rec. **45**:236, 1930.

6. Pohlman (footnote 5, second reference).

by bone conduction longer than do normal persons under the usual conditions of the test. The phenomenon is not real because the masking effect of the noises on the person with normal hearing is what is really being tested. It is therefore not improbable that a similar factor may enter into comparative tests on acuity of air conduction. To illustrate this point, I will narrate my own experience. In my previous article, all of the patients with negative Rinne reactions, averaged in group A, heard the loud speaker, the air receiver and the bone telephone more acutely above 4,000 double vibrations than I did. However, this condition was reversed below 2,048 double vibrations, at which point my acuity is quite normal. In the patient this does not indicate that the apparatus for the transmission of sound shows greater loss at the low frequency end of the audible range, but it does demonstrate that I am distinctly presbycusic and am likely to place the accepted interpretation on my observation. If I hear the lower frequency range at normal intensity, then my own sound transmission and perceptive mechanism may be considered as relatively normal. However, if I hear low frequencies at normal intensity, then I should hear all frequencies at normal intensity, because the apparatus for the transmission of sound is equally efficient at all frequencies. If I do not, then I must assume a perception deafness which should register both by air and by bone transmission; which it does. A person with normal hearing will hear all frequencies better with normal perception apparatus than one with conduction deafness. The more pronounced the presbycusis in the examiner, the more pronounced the low pitch disability in patients with conduction deafness, and this phenomenon is not real. The — x — line in figure 1 shows the acuity of air conduction of my left ear.

The second possibility, however, implies a real phenomenon, and the question may be stated as follows: Is it true that persons with conduction deafness with an equal depression in the acuity for hearing the entire pitch range, show greater disability at the low frequency end of the audible range? The answer is in the affirmative because they show relatively greater losses at both ends of the audible range than in the region of the intermediate frequencies. This fact is dependent on the correlation between the sensitivity of the end-organ and its capacity to handle intensities. This correlation was first established by Wegel [7] and is included in the Western Electric audiometric chart (fig. 1).

7. Wegel, R. L.: The Physical Examination of Hearing and Binaural Aids for the Deaf, Proc. Nat. Acad. Sc. **8**:155, 1922.

Here the average normal sensitivity for the range from 32 to 16,384 Hertz is arbitrarily indicated at a zero line. The column of figures on the left represents the depression in acuity as sensation units. These sensation units mean definite increases in intensity and may be translated as follows: 10 sensation units equal 10^1 or an increase in intensity of 10; 20 sensation units equal 10^2 or 100; 30 sensation units equal 10^3 or 1,000, etc. The light, broken, curved line shows the level of intensity found in the total loss of serviceable hearing or the point at which the intensity of the signal becomes a tactile or even painful quantity. The range of intensity may accordingly be defined as the difference between the minimum and the maximum stimulus; at 64

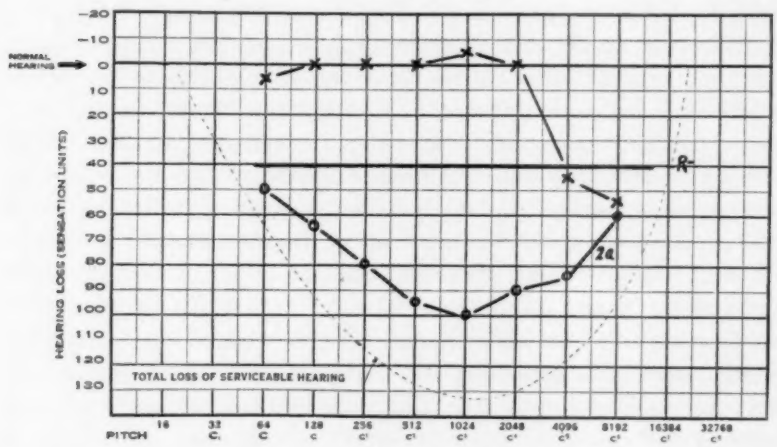

Fig. 1.—Audiometric chart. The —x— line represents the air acuity of my left ear; the —o— line represents the normal sensibility, and the light, broken curved line indicates the level of intensity found in the total loss of serviceable hearing.

double vibrations it is 60 sensation units; at 1,024 and 2,048 double vibrations, 130 sensation units, and at 8,192 double vibrations, 90 sensation units. Suppose a case with normal perceptive mechanism and complete conduction deafness which has resulted in an even depression throughout the range of 40 sensation units (fig. 1). The question is not how much has been lost, but how much remains. At 64 double vibrations this is a factor of 20 sensation units; at 1,024 double vibrations, 90 sensation units, and at 8,192 double vibrations, 50 sensation units. The patient, therefore, through an even depression of the acuity for hearing sounds by air conduction, has accordingly suffered, relatively, the greatest loss at 64 double vibrations; somewhat less at 8,192 double vibrations, and least through the range of from 1,024 to 2,048

double vibrations. This result is dependent on the fact that the region of greatest sensitivity in the internal ear is at the same time that with the greatest range in intensity. The result is therefore a real phenomenon that has nothing to do with the efficiency of the apparatus for the transmission of sound.

Mangold stated emphatically that a patient in whom the drum membrane and outer ossicles have been removed shows greater loss at the lower frequency end of the audible range. But according to what has been proposed here, a case of this type should conform to the case in which there is a typical negative reaction to the Rinne test with fixation of the stapes.

Case 1 was first presented at the International Congress at Copenhagen (1928)[8] as representative of the results obtained by Kranz and myself in our quantitative studies at the Riverbank Acoustic Laboratory.

Case 1.—A woman was quantitatively examined before and after a bilateral ossiculectomy performed by the late Dr. Robert Barclay of St. Louis. The acuity curves for air conduction of the right and left ear were established shortly before the operation and proved to be nothing more than depressed normal curves throughout the range tested, with somewhat greater loss on the right. She was retested about five days after the operation, and it was found that the acuity on both sides was practically unchanged. This observation was construed as evidence that the apparatus for the transmission of sound had been functionless on both sides; the similiarity of the curves to those for normal acuity indicated that the normal apparatus for the transmission of sound must be uniformly efficient throughout the audible range, and finally, that the transmission of sounds by air conduction through the drum membrane into the cavity of the middle ear was not materially blocked by the presence of the drum membrane. (This last point will be discussed in reference to case 2.)

Fortunately, the patient showed a marked enhancement of acuity of air conduction when a cotton prosthesis was used on the left or better ear, and recently she reappeared for examination. The Rinne test was negative for 256, 512 and 1,024 double vibrations with Riverbank magnesium-alloy forks with no evidence of lateralization from the vertex.

The acuity by air conduction was taken with a Western Electric 2a audiometer on three days with two day intervals with and without the prosthesis; the readings were averaged and are shown in figure 2. The solid line indicates the acuity of the right ear; the —x— line that of the left ear without the prosthesis; and the —o— line that of the left ear with the prosthesis As the patient did not hear either 64 or 8,192 Hertz on the right at the maximum output of the apparatus, these readings have been omitted from the lower curve. It will be noted, however, that the depression for all the curves is no more than a relatively even depression throughout the range heard. With the prosthesis, the average enhance-

8. Pohlman, A. G.: Experiments on Minimum Acuity and Their Relation to the Problem of Middle Ear Mechanics, Cong. Internat. d'Oto-Rhino-Laryng., Copenhagen, 1928, p. 507.

ment throughout the range from 128 to 4,096 double vibrations inclusive was about 20 sensation units, and 64 and 8,192 double vibrations were heard consistently below the maximum output level of the apparatus. The enhancement of the acuity of air conduction is, if anything, slightly greater at the upper frequency end of the test range. This is similar to the case reported by Lillie and Kranz.[9]

It is interesting to note that without the prosthesis the patient consistently gave a negative Rinne reaction for the three frequencies tested with forks, and with the prosthesis in place she quite as definitely gave a positive reaction. This confirms my observation, previously reported, on patients with negative Rinne reactions, that a negative reaction at one frequency indicates a negative reaction at all frequencies, while a similar result obtains for positive reactions to this test.

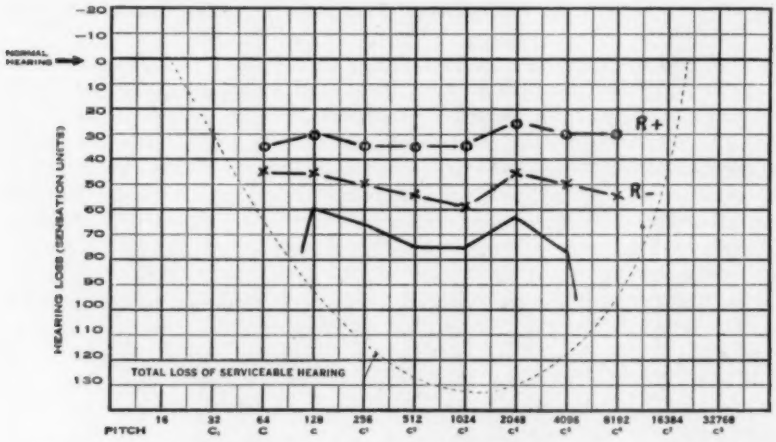

Fig. 2 (case 1).—Audiometric chart. The solid line indicates the acuity of the right ear, the — x — line that of the left ear without the prosthesis, and the — o — line that of the left ear with the prosthesis; the light curved, broken line shows the level of intensity found in the total loss of serviceable hearing.

A similar interpretation has been advanced quite independently by Sonntag.[10] The fact that negative Rinne reaction at 256 double vibrations implies a negative reaction at 2,048 and at 4,096 double vibrations cannot be established by fork tests, because these frequencies lie beyond the upper range of such tests. If, therefore, this case changes from a negative to a positive Rinne reaction for the fork test on the basis

9. Lillie, H. I., and Kranz, F. W.: A Quantitative Study of Hearing with and without Cotton Plug Prothesis in the Middle Ear, Ann. Otol., Rhin. & Laryng. **33**:458, 1924.

10. Sonntag, R.: Derklinische Wert des Oto-Audion, Arch. f. Ohrenh. **125**:79, 1930.

of the quantitative curve, there is no reason to suspect that a similar condition does not obtain at the higher frequency level. If, however, the change from negative to positive obtains at the low frequency end of the audible range, then this change should not obtain for higher frequencies if the apparatus for the transmission of sound by air is not efficient in the transmission of such frequencies. Personally, I am prepared to assume that if a glycerin-cotton tampon will increase the acuity for hearing 4,096 and 8,192 double vibrations by a factor of 25 sensation units, a normal drum membrane and ossicular chain may be even more efficient at this pitch level.

The interpretation in this case is that the patient hears just as a normal person hears, except that a greater intensity is required at all frequencies, and this accounts for the intelligibility of telephone conversation in complete cases of conduction deafness. There is no evidence for the deformation of the reception as implied in the accepted interpretation of the condition. The case supports the conclusions made in a previous article.

A discussion of the second case to be reported requires a somewhat more detailed statement, because it is related to the function of the drum membrane and ossicular chain as an impedance matching transformer and is similar to a closed-back telephone transmitter in its physical behavior.

If one considers the internal ear as acoustically insulated by a factor of about 40 sensation units, then the middle ear apparatus may be regarded as a mechanical transformer with this efficiency. As the transformer may be considered of equally functional efficiency throughout the pitch range, the discussion on the transformer itself may be limited to the amplitude responses or the intensity transfer.

The physical principles involved are shown in diagrammatic form in figure 3, which presents an auditory canal (*1*); the drum membrane (*2*); the apparatus for the transmission of sound (*3*), extending from the drum membrane to the oval window (*4*); the cochlea (*5*), represented as separated incompletely by the lamina spiralis and the basilar membrane (*8*) into an upper scala vestibuli (*6*) and a lower scala tympani (*7*). The two scalae are confluent at the apex on the cochlea at the helicotrema (*9*), and the scala tympani ends proximally at the round window with its membrana tympani secundaria (*10*). The cavity of the middle ear (*11*) is shown as functionally closed by approximation of the walls of the auditory tube (*12*).

The push and pull of the air of the external auditory canal by the sound is arbitrarily indicated by the length of the arrow *a*. It must, of course, be remembered that normally this amplitude may be of

microscopic and even ultramicroscopic proportions. The drum membrane follows the push and pull of the air applied to it at considerably reduced amplitude (arrow *b*), and these vibrations are either transmitted to the perilymph at the oval window by the apparatus for the transmission of sound (arrow *d*) or to the air of the middle ear (arrow *c*). The amplitude of response at either *c* or *d* cannot be equal to that of the drum membrane, let alone that of the air in the external auditory canal. The changes in pressure in the middle ear (arrow *c*) are necessarily transferred to the entire wall and therefore affect the membrane of the round window and also the liquid of the scala tympani (arrow *e*). The transformer effect in the apparatus for the transmission of sound is dependent on the differences in area at the low impedance end

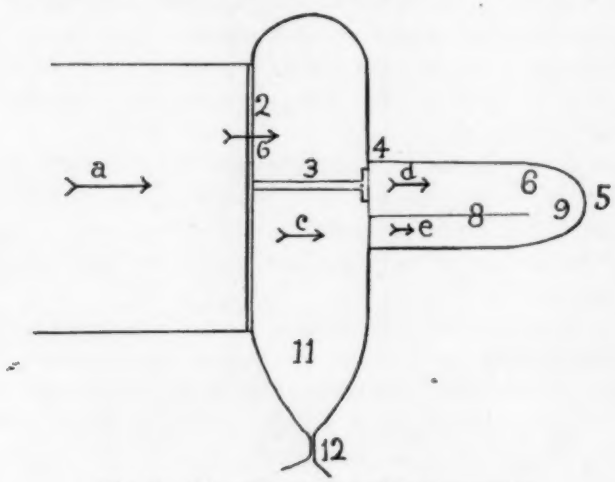

Fig. 3.—Diagram of an auditory apparatus.

of the system (drum membrane) and at the high impedance end (foot-plate of the stapes). The efficiency of the transmission of vibrations from the drum membrane through the foot-plate of the stapes (*b* to *d*) is accordingly greater than that through the route from *c* to *e*. The experimental evidence cited in the previous article indicates that the contribution to the response in intensity at *d* through the direct transmission to *e* is too small to come to consciousness. Accordingly, if the drum membrane and ossicular apparatus are at all functional, the stimulation to the end-organ is in terms of this route (*b* to *d*). When, however, the system for the transmission of sound is completely out of commission, the stimulation is in terms of the route from *c* to *e*. This difference between the normal case and that with fixation of the stapes is represented by the factor of about 40 sensation units, as shown in case 1.

The efficiency of the vibratory response of the drum membrane is in part dependent on the fact that the auditory tube is functionally closed, because this places the middle ear apparatus under the conditions of a telephone transmitter with a closed back, with vibrations applied only on the open side of the diaphragm. If the auditory tube was open, then the conditions in the schematic figure 4 would obtain. Here the sound pulses entering the nose would pass into the middle ear directly through the auditory tube (arrow *f*) and the pressures would be applied to both sides of the drum membrane at the same time. The result would be a cancellation effect on the vibrations of the drum membrane, and if the pressures were equal, the cancellation would be complete. However, the responses of pressure in the cavity of the

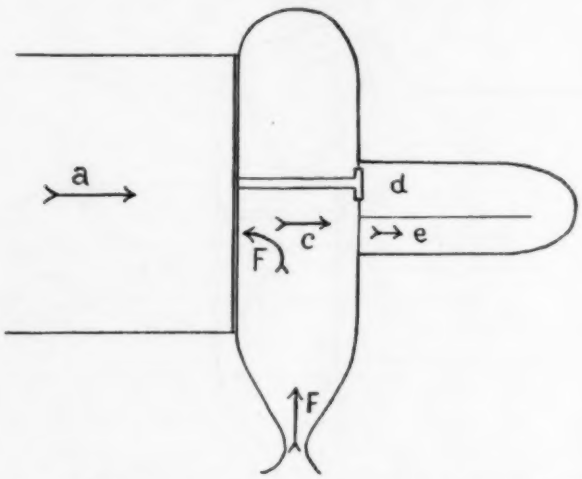

Fig. 4.—Diagram of an auditory apparatus in which the auditory tube is open.

middle ear would be increased because of the continuity of the air with that of the nasopharynx. The result would be found in decreasing the amplitude response at arrow *d* to practically zero while that at arrow *e* would be somewhat increased. In other words, if a person with a positive Rinne reaction (functional apparatus for the transmission of sound) could hold the auditory tube open, the acuity for hearing sounds transmitted by air conduction would be materially decreased. On the other hand, a person with a negative Rinne reaction with ankylosis of the stapes might hear the sounds transmitted by air conduction through the auditory tube at less intensity. This may appeal to the reader as speculation based on juggling the alleged physical conditions rather than as an argument. I therefore present the relations as they were found in case 2.

This patient was operated on by Nesfield, of London, in 1928. The operation [11] consisted in making a by-pass around the drum membrane from the mastoid into the external auditory canal, as shown diagrammatically in figure 5. The result of this by-pass should be similar to that which might be expected if the tube was open. The by-pass (*x*) tended, however, to be closed by a pseudodrum membrane (*y*) which formed across the opening into the external auditory canal, and when this occurs, the case necessarily returns to the condition shown in figure 6.

Case 2.—S. J., aged 50, a resident of British Columbia, a machinist, intelligent and cooperative, gave a history of chronic catarrhal deafness which began in

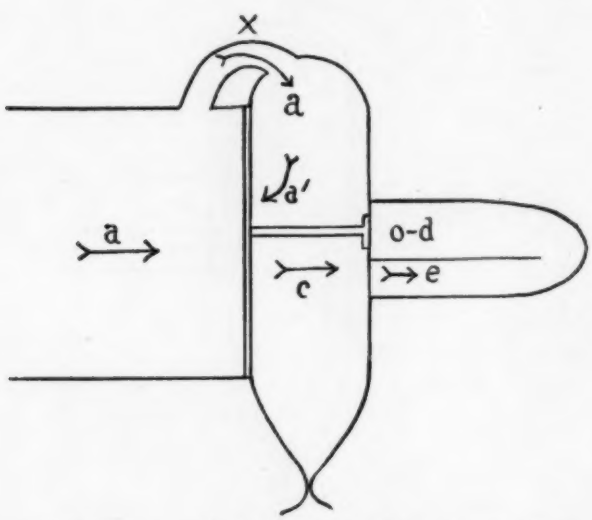

Fig. 5 (case 2).—Diagram showing the site of operation. A by-pass was made around the drum membrane from the mastoid into the external auditory canal.

1911 and had grown progressively worse. He was variously treated, including a year of chiropractic without appreciable effect. He reported to Nesfield in the summer of 1928, was operated on and returned home. He was instructed that in time the adventitious opening would be closed off by a membrane and that it was necessary that this membrane be opened. A local physician could not find the opening, and the patient was finally referred to me by Nesfield, possibly because I happened to be present at the time of the original operation.

The patient gave a negative Rinne reaction to the test on both sides, with a slight lateralization to the left. This was checked by alternation of the forks on the mastoids. The audiometric observations are reported in figure 7. The acuity for air conduction for the better and unoperated ear (the right) is shown as a solid line, and for the left and operated ear as an — x — line with the

11. Nesfield, V.: An Operation for the Alleviation of Deafness, Lancet **2**:1338, 1927.

by-pass closed at the time of the first examination. The right ear presents a typical curve for conduction deafness superimposed on a presbycusis. It will be noted that the acuity drops below the level of the 40 sensation unit beginning at 512; is more pronounced at 2,048 double vibrations and that neither 4,096 nor 8,192 double

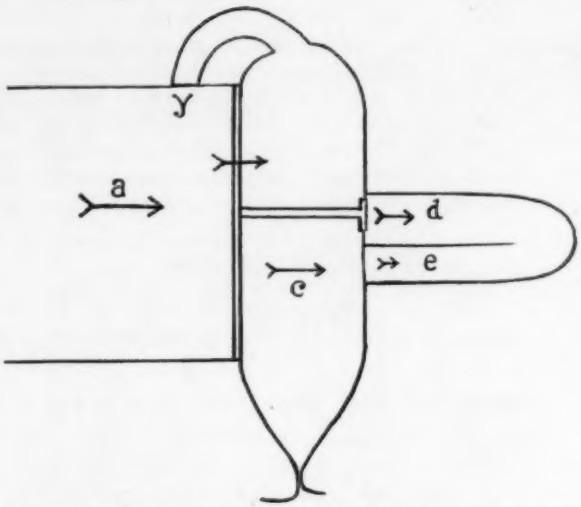

Fig. 6 (case 2).—Diagram showing the result of operation on a patient in whom the by-pass (x) tended to be closed by a pseudodrum membrane (y) which formed across the opening into the external auditory canal.

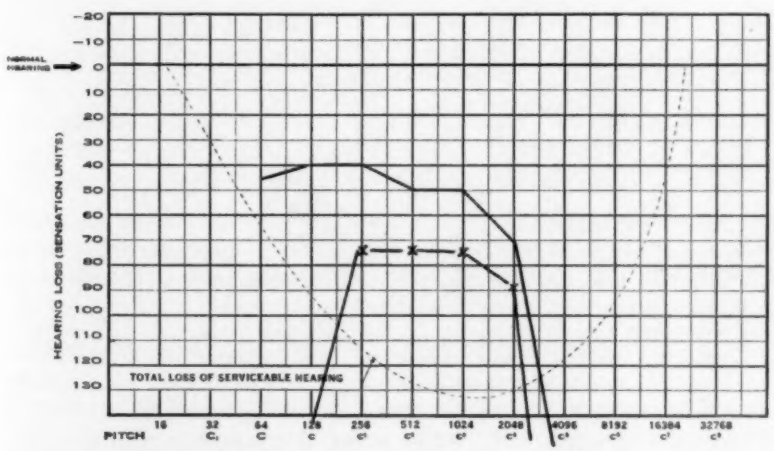

Fig. 7 (case 2).—Audiometric chart. The solid line represents the air acuity of the better and unoperated ear (the right); the —x— line represents the air acuity for the left and operated ear, with the by-pass closed at the time of the first examination; the broken, curved line shows the level of intensity found in the total loss of serviceable hearing.

vibrations could be heard at maximum output. The left ear, the one on which operation was performed, did not respond to either 64 or 128 double vibrations (Hertz) with more pronounced lowering than on the other side at 256, 512, 1,024 and 2,048 double vibrations, and neither of the two uppermost frequencies were heard. The four readings taken have been arranged in tabular form and averaged (see table).

The external auditory canal was swabbed out with boric-alcohol, and the occlusion membrane was located and incised by Dr. W. E. Sauer of St. Louis. Examination was again made and improvement noted (1 and 1*a*). The canal was packed with gauze, and when the patient returned on the following day the gauze was filled with blood. Tests were again made before and after the gauze was removed (2 and 2*a*). The canal was left open, and on the third day the patient was again examined. The canal was now found to be occluded by clot,

Results of Four Readings

	Right Ear						
	64	128	256	512	1,024	2,048	Comment
Oct. 30	45	40	40	50	50	70	
Oct. 31	35?	50	40	45	50	70	
Nov. 2	45	40	45	45	50	70	
Nov. 3	..	50	55	60	65	75	
Average	..	45	45	50	54	71	
	Left Ear						
	64	128	256	512	1,024	2,048	
Oct. 30 (1)	..	..	75	75	75	90	Occluded with membrane
Oct. 31 (2)	..	55	55	55	65	90	Occluded with gauze
Nov. 2 (3)	..	60	65	70	70	90	Occluded with clot
Nov. 3 (4)	..	..	70	70	70	90	Occluded with clot
Average	..	..	66*b*	67	70	90	By-pass canal closed
	Left Ear						
	64	128	256	512	1,024	2,048	
Oct. 30 (1*a*)	..	45	50	45	45	90	Membrane incised
Oct. 31 (2*a*)	50	40	50	50	55	90	Gauze removed
Nov. 2 (3*a*)	..	50	50	50	55	90	Clot removed
Nov. 3 (4*a*)	..	55	55	60	65	90	Clot removed
Average	..	48	51	51	55	90	By-pass canal open
Average increase	..	..	15	16	15	0	

and tests were made before and after its removal (3 and 3*a*). The last examination was made on the following day, when the canal was again found to be occluded with clot, and again tested before and after its removal (4 and 4*a*). It will be noted in the table, reading downward and comparing the condition with occlusion with that without occlusion of the operative canal that an increased sensitivity obtained under the latter condition. With occlusion 64 double vibrations with the Hertz fork was never heard, but it was heard once without; 128 double vibrations was heard only twice with occlusion at about maximum output, but it was heard consistently under the maximum output without occlusion. The average enhancement at 256, 512 and 1,024 double vibrations was about 15 sensation units, while at 2,048 double vibrations no difference was noted.

The phenomenon is a real phenomenon, and the patient actually does hear better with the operative canal open than with the canal closed. However, it will be noted that the improvement was not suffi-

cient to transform the reaction to the Rinne test from negative to positive, nor was the enhancement sufficient to increase the acuity of the poorer ear to that of the better ear, which was likewise negative to the Rinne test. It is at once obvious that the difference may be explained only on the basis that the apparatus for the transmission of sounds by air conduction was functionally out of commission, and that the enhancement was due to an increased vibratory response in the middle ear through the open communication. It is also obvious that the maximum efficiency in hearing with a normal perception mechanism could not be greater than a loss of 40 sensation units, and unless the operation was successful in restoring the efficiency of the apparatus for the transmission of sound this figure is the maximum improvement that might be expected. It is also to be noted that if the transmission system is restored to some degree of functional efficiency, then opening of the occlusion membrane should decrease, not increase, the acuity of hearing.

In case 1 the improvement noted through prosthesis took in the entire frequency range; however, in case 2 the opening of the by-pass favorably affected all the frequencies up to and including 1,024 double vibrations with the Hertz fork, but had no effect on that of 2,048 double vibrations. Why was this frequency unaffected? While the answer may not be a definite one, at least two probabilities may be suggested. The first probability is that the small opening and tortuous course to the middle ear affected the transmission of high frequencies more than it did that of low frequencies. The second probability is that the patient did not hear sounds transmitted by air conduction at all and what he was listening to was the tremble of the receiver (transmission by bone conduction). It has been definitely shown that when the intensity developed by the air receiver attains a factor of 60 sensation units, sufficient energy is delivered to be heard across the head of a normal person. It would therefore seem logical to assume that only sounds transmitted by bone conduction were heard under both conditions of the test because of the degree of disability in the end-organ itself (presbycusis). It may also be suggested that a paracentesis would probably have accomplished a similar improvement in this particular case.

The evidence also indicates that the drum membrane in this case was a barrier, at least at 256, 512 and 1,024 double vibrations (Hertz), equivalent to 15 sensation units, while in case 1 this effect was not noted. The answer here is again unfortunately incomplete, because I have no direct knowledge of the conditions of the drum membranes in case 1. However, in the cases with a negative Rinne reaction, reported in a previous paper, no unusual thickness of the drum mem-

brane was found, except in one carefully observed case, nor is it characteristic of cases of undisputed ankylosis of the stapes. The drum membranes in case 2 were, however, much thickened and very opaque.

If the idea championed by Specht that the drum membrane and ossicles are not functional in the transmission of sound but act as a selective counterpoise is considered, certain objections apart from his rather remarkable statement on the pressure in the middle ear with and without the drum membrane may be considered. It has been pointed out that a maximum pressure of sound pulsations through the air on the middle ear would occur if there were no drum membrane present, and the interpretation of case 2 is that pressures in the middle ear were increased when the by-pass channel was opened. Specht's conception that cases of fixation of the stapes are cases of low frequency deafness, because the necessary counterpressure through the ossicles is wanting, is not borne out by the facts as they developed in these cases. Case 1 should have shown greater depression at the low frequency area than at the high frequency area without the prosthesis, if Specht is correct; the improvement at low frequencies should have been greater than at the high frequency end with the prosthesis, while the reverse occurred.

The observations on conduction deafness, whether made with forks or with the audiometer, are essentially correct, because there is a relatively greater loss of hearing at the low frequency end of the pitch range. This however, as has been pointed out, is an expression of functional response in the internal ear, and is not in any way related to the efficiency of the drum membrane and ossicles in the transmission of various frequencies. The observations, in other words, may be classed as real phenomena, but the interpretation in terms of function of the middle ear has been erroneous. The argument advanced by Runge that pitch selectivity for the transmission of lower frequencies by air conduction is supported by the establishment of a similar function in the transmission by bone conduction has been answered in the previous article. There is no evidence that the normal conduction system for the transmission of sounds by air conduction is operative for that by bone conduction at any frequency. This is true as long as the external auditory canals are not occluded or if the drum membrane has not been loaded, as in Runge's water-filling test, on which he bases his conclusion as stated.

SUMMARY

1. The apparatus for the transmission of sound is about equally efficient in the transmission of all audiofrequencies to the cochlea.

2. The usually accepted interpretation that conduction deafness results in greater losses in acuity for hearing low pitch tones because the apparatus for the transmission of sound is more efficient at the lower end of the pitch range is incorrect.

3. The fact that relatively greater losses in acuity occur at the lower end of the frequency range is dependent on an equal efficiency in the apparatus for the transmission of sound and on the correlation between the range of sensitivity and intensity at the various levels of the perceptive apparatus. The conduction deafness, therefore, merely brings to consciousness the normal reaction of the internal ear itself.

PHYSICAL THERAPY IN THE TREATMENT OF DISEASES OF THE EAR, NOSE AND THROAT *

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I began to use physical therapy in every disease for which it is recommended, and wasted considerable time doing so; for instance, in disease of the sinuses it is physically impossible to secure benefit from the local application of ultraviolet light in the nasal chambers except for some improvement in the condition of the mucous membrane of the nose. Other agencies, however, which are not so expensive and time-consuming, give even better results. A combined method is to be preferred. Likewise, unless the drum is absent, it is a waste of time to apply ultraviolet light to the ear in the hope of clearing up otitis media, as it is physically impossible for the rays to penetrate the drum membrane.

After a certain length of time one discovers that electrotherapy will help in certain conditions and will not have any influence in others, as is the case in any other form of treatment. Also the personal equation enters strongly into the problem, for good judgment is a necessary attribute of the operator of an apparatus for physical therapy. It must be decided whether the case is suitable for this form of treatment, and the amount of current or light must be carefully gaged.

DIATHERMY

Diathermy is a much maligned as well as much praised method of therapy. In the hands of those who understand its uses and proper method of application, it is unquestionably one of the most successful forms of treatment.

Surgical Diathermy.—By the use of a small electrode, diathermy may be employed surgically to remove all forms of growth, no matter how large; it leaves a smaller scar and less contraction of the surrounding tissues than other methods. Also sterilization of the adjacent tissues is accomplished, which prevents subsequent spreading of the growth.

Lynch, of New Orleans, was formerly enthusiastic regarding the removal of papillomas of the larynx by this means. Of late years, however, he has lost considerable of this enthusiasm although diathermy is probably the most successful means of removal; that is, it shows the smallest percentage of recurrence. I gained this idea at his clinic about two years before the present writing.

* Submitted for publication, Feb. 9, 1931.

My experience with surgical diathermy has been in removing small growths about the face and in coagulation of the tonsils. About the latter procedure there is considerable discussion among those who do not employ it. It was with a great deal of skepticism that I began to use it, and my first experience was discouraging. The reason for this was my attempt to remove the tonsils by desiccation, a method that employs the spark and is necessarily tedious. The reaction from this method is slight, and the patient does not complain of much soreness of the throat between treatments. Such a great number of treatments is required, however, that the surgeon and the patient become weary of seeing each other before the removal of the tonsils has been accomplished.

Coagulation is unquestionably the method of choice, and the tonsils are successfully removed in from three to five or more treatments. A clean throat is left; the tonsillar fossae are smooth and the pillars untouched and, so far as can be seen, the capsule is destroyed. When one removes the tonsils to eradicate an acute complication, such as arthritis, an improvement is often noticeable after the first treatment. The absence of postoperative hemorrhage is one of the advantages mentioned for removal of the tonsils by diathermy. This complication, however, has occurred on several occasions in my experience, twice severely; in one case it was necessary to suture the tonsil. This is rare, however, whereas slight hemorrhages are comparatively frequent. Formerly I removed the tonsils in four sittings, treating both tonsils at one sitting. It is now my custom to treat only one tonsil alternately, at weekly intervals, and to give six treatments, or more if required, to each tonsil. The reason for lengthening the period of treatment is to prevent too much sloughing of the tissues and resultant bleeding, and also to reduce the pain after treatment. If one tonsil is treated at a time the patient is not so uncomfortable between treatments.

There are numerous electrodes on the market, each one recommended by its designer, and no doubt one is as successful in results as the other. I formerly employed the Plank needle, having the patient sit on a seat furnished with the diathermy machine. I am now using the Doane indifferent electrodes with the Plank needle in place of the seat. These electrodes are shaped in rings to fit over the tonsil, and there are pillar retractors which also act as electrodes if desired. By this means the depth of coagulation can be more carefully gaged and the postoperative reaction is not so great.

The patient should not be misled by the statement that the throat will not be sore after the tonsils are coagulated; if there is no soreness, the treatment has been valueless. Some patients complain bitterly of the soreness, whereas others state that it is not severe.

Although I coagulate a great many tonsils, my method of choice is still the use of the knife. This is always the advice that I give my

patients unless some complication is present that contraindicates an operation, or, as is frequently the case, the patient does not wish to be absent from work for the necessary time.

Medical Diathermy.—In the treatment for deafness, I have found diathermy to be a valuable aid, and employ it in all cases whether the high or low tones or both are affected. Its value is easily determined in those cases in which the eustachian tubes are patent, the high tones are slightly affected and a positive Rinné test is obtained. Ordinarily I search for any possible foci of infection and, finding none, tell the patient that treatment will be useless; in a number of these cases, however, the hearing has been markedly benefited by treatment with diathermy. The electrodes should not be allowed to grow hot, but just enough heat should be generated to keep them comfortably warm; with the use of the Pollard electrodes this requires 150 ma. More current causes temporary dizziness when the electrodes are removed. This is not the ideal method of employing diathermy in treatment of the ear, since one is not able to apply the maximum amount of heat, but it is time-saving. Instead of soapsuds I employ a lubricating jelly to obtain even contact with the tissues.

Diathermy is also effective in the exudative types of otitis media. I do not employ it in chronic suppurative otitis media, although it no doubt would be helpful.

In disease of the sinuses I limit its use to relief of pain in infections of the acute frontal sinuses and in subacute sinusitis that does not respond well to treatment. In directing diathermy to the sinuses one must be sure that drainage is adequate as considerable congestion is caused and complications may occur.

I believe that diathermy is going to prove an effective remedy for acute rhinitis and that its use will become universal in the treatment for this common disease. It is only recently that I have begun to experiment with its use for this purpose, and I should not care to make any definite statement regarding it.

Diathermy is the only form of treatment that I have ever seen, with the exception of vaccines, that is of any benefit in furunculosis of the ear; it is the ideal treatment and one application will often abort the condition.

ULTRAVIOLET LIGHT

Diseases of the Ear.—Ultraviolet therapy has been highly recommended for furunculosis of the ears, but I saw no benefit derived from a thorough trial of this form of treatment in about fifty cases of this condition. Prior to purchasing a water-cooled quartz light, I employed the Curay light in numerous cases without any benefit that could be ascribed to the treatment.

In cases of chronic otitis media with an absence of a large part of the drum, I have stopped the discharge temporarily by this means in a much shorter time than by other methods, and the relief has been of longer duration. If there is no large perforation, however, treatment is useless.

Eczema of the ear is markedly benefited by this form of treatment, but I have not effected a cure by this means. In my opinion, eczema is a systemic and not a local condition, and no cure is to be expected until the focal infection or dietary disorder is corrected. Broadly speaking, irradiation of the body with the air-cooled lamp is to be preferred to local treatment by means of applicators, as by this means the patient's resistance is raised, and he is better able to take care of the infection.

Diseases of the Nose and Accessory Sinuses.—Local applications by means of the quartz rods are markedly beneficial in acute coryza. I always employ this form of treatment in conjunction with colloidal silver packs, and am firmly convinced that results are oftener and more quickly obtained by the combined treatment than when the packs alone are employed.

In chronic rhinitis of all types, I have not obtained sufficient results from this form of treatment to make it worth while.

Lupus of the nose, whether affecting the skin or the mucous membrane is much benefited by irradiation. The process was halted by this method in the only case that I have observed; it had not cleared up, however, when the patient was last seen.

Vasomotor conditions of the mucous membrane of the nose have reacted better to screened ultraviolet rays than to the unscreened rays. The Hanovia factory made me a special adapter for the quartz lamp in which a slot had been cut; they also furnished a uviol glass window to fit in this slit. Thus the very short ultraviolet rays are cut out and a longer exposure is possible, starting at four minutes and increasing the period one minute at each treatment until ten minutes' irradiation is given. This treatment has been successful in some cases, but fails completely in a large percentage.

I have given up irradiation in hay-fever as I could see no benefit from it.

I have not found irradiation of the sphenopalatine ganglion successful. The Curay Company made me a special applicator with a small bend at the distal end for irradiating this region, but I have found that it can be employed in only a small proportion of patients, owing to its size; however, it is as small as it can be made to give any benefit.

In disease of the sinuses the only improvement that one could expect to obtain would be in the mucous membrane of the nose, better drainage being afforded. In one patient, however, who underwent removal of the posterior ethmoids on the right side, there was a return of the discharge, for which she did not consult me until two years later;

she obtained complete relief after treatment with the unscreened light. Of course, the sinus had been opened, and it was possible for the light to act directly on the part affected. However, this case does not seem significant.

In disease of the sinuses, especially in children, irradiation of the body with the air-cooled lamp is, without doubt, useful. These treatments must be given so as to obtain a mild reaction of the skin, just sufficient to act as a tonic and increase the resistance of the patient to the infection. An overdose of the rays acts like an overdose of alcohol in an acute febrile disease: The tonic effect is lost and it would have been better if the patient had not had the treatment. To children who have colds frequently, it is my custom to give a series of treatments twice each winter; this decreases the number of infections and shortens the course of those which they contract.

Diseases of the Throat.—Infectious ulcerations of the pharynx and tonsils seem to be benefited by local application of the quartz light, but I never depend on this form of treatment alone. Vincent's angina is unquestionably benefited by it, and I believe that it is the most efficient remedy for that disease. However, I employ acriviolet dye in conjunction with the quartz light and sometimes chromic acid, but the acriviolet is to be preferred owing to its ability to destroy both the gram-negative and gram-positive organisms.

The unscreened rays should not be used for tuberculosis of the larynx, as they might cause irritation. One of my patients whom I treated with the uviol screen was markedly benefited for a time, but had a relapse.

OTHER FORMS OF PHYSICAL THERAPY

Galvanism.—There is no question but that some persistent cases of chronic suppurative otitis media heal by electrolysis when there is an opening in the drum sufficiently large for the treatment to have an effect, whereas other cases do not seem to be benefited. If a cessation of the discharge is obtained, it is likely to be of longer duration than that following ordinary treatment, but it is a waste of time unless a fairly large perforation of the drum is present.

I have seen favorable reports concerning this form of treatment in turgescent rhinitis. I have never employed it for this purpose, however, and can neither condemn nor praise it.

Galvanism offers an excellent method of removing papillomas. However, as the patient complains of slight but disagreeable shock, I prefer diathermy.

Galvanism is the best method of removing varicosed vessels of the skin, especially on the nose, since by the insertion of a fine platinum needle it is possible to enter the vessel and destroy it with 1 ma. of current in one treatment.

Galvanism offers one of the best means of relieving so-called neuralgia through the application of pads soaked in saline solution.

Infra-Red Light.—Infra-red light is of value in relieving pain from acute infection of the sinuses, especially the frontal sinus. I have also found it useful in inflammation of the eye, iritis and acute glaucoma. No doubt, the favorable results are due to the heat generated and not to the rays emanating from the lamp.

AIDS TO DEAFNESS

Kinesiphone.—I mention this machine for the reason that its inventor, Dr. Maurice of Paris, asserted that it was useful in cases for which there is ordinarily no help, those in which the otologist advises the patient to learn lip reading or to buy some mechanical aid to hearing. At considerable expense I purchased one of these machines and employed it in a number of selected cases for which it is recommended. The treatment was an absolute failure, except for one case which showed great improvement. It is possible that my not being an adept in the handling of the machine affected the results, but my experience discouraged me from experimenting with it further.

Audotor.—The audotor was used in a selected number of cases, the results being checked with the audiometer. None of the patients obtained any benefit from the machine.

CALCIGEROUS METAPLASIA OF THE AURICULAR CARTILAGE *

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In the practice of otolaryngology the rare types of abnormalities naturally arouse unusual interest. Apart from such considerations as the treatment, prognosis or morbidity of a disease, its infrequency enlists the desire to know more about its etiology and concomitant changes in the body, if any, and to summarize the whole knowledge and experience of it to date.

The literature includes reports of few cases of calcigerous metaplasia of the auricular cartilage, although it has been encountered with enough frequency to warrant mention of it in the texts of Dench, Bacon, Politzer, Urbantschitsch and Heinman. The following quotation from Dench [1] is the most concise summary of present knowledge of the condition:

> Curiously enough, this condition is exceedingly rare, although several instances have been mentioned in otological literature. The causes which may be considered to be active in its production seem to be malnutrition, severe local inflammation, or some profound disturbance of the circulation of the part, such as exposure to intense cold. When osseous tissue has once been deposited, the recognition of the affection is exceedingly simple. The auricle becomes stiff, inflexible, and boardlike to the touch. The ossification may be limited either to a small area or may involve a considerable portion of the organ. The helix scaphoid fossa, and anti-helix are the regions most frequently affected, and the condition may be present upon one or both sides. Relief is demanded both on account of the deformity and because of the pain which any pressure upon the rigid organ causes, as when the patient attempts to lie upon the affected side.

Bacon [2] mentioned that ossification of the auricle as a result of perichondritis has been reported, but is of rare occurrence.

The first report of a case was made by Bochdalek [3] in Prague, in 1866. At that time he was able to find but three cases in a careful search of the literature. When he was in the Institute of Anatomy, while dissecting the body of a man aged about 65 or 70, he discovered this abnormality in both ears. Examination did not reveal a trace of a pathologic process, either in the skin or in the perichondrium, but microscopic examination showed true bone substance. Bochdalek drew the following conclusions: 1. The cartilage of the ear may ossify without showing signs of inflammation. 2. The observations by authors of his own and earlier days of fractures of the cartilage in the ear were well founded, although up to that time such a fracture was presumed by the majority to be impossible.

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The second case was reported by Voltolini [4] two years later. He said: "Up to the present time I have observed only one case in which the cartilage of the ear was ossified. According to my opinion this occurrence is very rare since ophthalmologists examine thousands and tens of thousands of ears and rarely find an ossification." The age of his patient was approximately 70.

Two years later, Gudden [5] reported the third case. This likewise was the first case seen by him, and he described the condition as extending practically throughout the entire extent of the cartilages of both ears. There was no trace of an earlier traumatism. The age of his patient was 70, and whether ossification or calcification was present is not stated.

The three cases reported up to 1870 apparently were free from any specific exciting cause and may be considered as unusual spontaneous changes occurring in senility.

In 1889, Gudden reported the first case of ossification of the cartilage due to pathologic processes in man.

A man, aged 22, who consulted Gudden for examination in June, 1889, gave the following history: His ear first troubled him during the summer of 1882, when he was 15 years of age. In August of that year, he noticed two small swellings close together at the edge of the ear. He considered them insect bites, although they did not itch; they were rather soft and slightly reddened. Within a few days, the two nodules had united so as to form one and seemed to be filled with liquid. The swelling was soft, and the liquid could easily be pushed from one point to another. The patient was not ill, and the ear showed no changes other than an alteration of form; there was no pain except when he pulled at it, which he seemingly did very often. He consulted a physician, who advised him to let the matter rest for three weeks in the hope of spontaneous recovery. A change did not occur during this period, so the patient returned to his physician, who lanced the tumor. A liquid, seemingly water, flowed out. After about a week the ulceration had healed and the sensation in the tumor was about the same as before, so that the wound was reopened. Each night a little water was discharged, but otherwise the tumor seemed to be an empty cavity. Soon after this it began to swell rapidly, and became red, hard, heavy and very painful. The patient consulted another physician, who diagnosed the condition as a large abscess and lanced it. A great mass of "substance" was discharged, and for some time the patient applied linseed bandages daily. The abscess again became as large as before. The ear no longer seemed hollow, but solid, and it was still soft. The patient was unable to recall when it first became hard. This was five months after the beginning of the infection. The following summer it was as hard as stone. The following winter the abscess was so hard that a fur cap could not be worn over the ears with comfort.

At the time the patient consulted Gudden his sense of hearing was good, but the auricle showed the particular type of deformity that has frequently been described as resulting from perichondritis. It was thickened and contracted, and the normal form had been replaced by irregular elevations and depressions. The most conspicuous of these was a cylindric protrusion which extended from the upper portion of the tip directly backward and downward, corresponding to the antihelix

and filling the fossa of the helix. It was as hard as wood and could not be moved. There was a certain rigidity in all parts of the auricle with the exception of the lobe, which showed normal consistency. The excessive hardness caused the author to assume the presence of ossification, and he advised amputation of the chief deformity, the upper and posterior portions. Operation was performed on Feb. 6, 1889. The bony mass removed was 1½ inches (3.77 cm.) long and ⅓ inch (1 cm.) wide. Anatomic examination of the specimen showed true bone substance, compact at some places and lattice-like in others, with deposits of bone at the edges. The specimens showed haversian canals with concentric layers, each having numerous projections typical of compact bone. At other places there was a system of wider medullary spaces which showed a continuous network of tissue rich in vessels and containing quantities of fatty cells. It was surrounded by trabeculae of true bone substance of varying widths, typical of reticular bone. At other points there were small islands in the connective tissue or in the reticular cartilage, which represented narrow cells arranged in rows, filled with a homogeneous granular content typical of Virchow's osteoid tissue. This tissue was separated from the reticular cartilage by a zone of irregular masses, defining the limits of the ossification. The reticular cartilage was covered by the perichondrium and the soft parts.

Gudden thought that the condition probably occurred more frequently than the reports showed, and he therefore urged physicians to observe their cases of seropurulent and hemorrhagic perichondritis for such pathologic changes. Ossification of pathologic products is usually a chronic process which frequently does not make its appearance until a number of years after the primary disease has disappeared. For this reason one may expect to find it, not in fresh cases, but in old ones. In the foregoing case, eight years elapsed before the ossification was diagnosed. It was impossible to determine at what time after the end of the inflammatory period the ossification began.

Knapp [6] collected the literature on this subject in 1891; he reviewed the previous cases, but did not mention a fourth case reported by Ludwig Linsmayer [7] in 1889.

A man, aged 75, who lived in an almshouse, for the past six or eight years had observed changes in his ear. He consulted Dr. Knapp and complained that he could not sleep because his ears were painful when he lay on either side. He attributed the malady to the fact that when a coachman earlier in his life he had frequently suffered from chilblains on his ears. He was almost deaf in the left ear, suffered from senile pruritus and showed a complete defect of the soft palate, which had been extirpated one and one-half years previously on account of epithelial carcinoma. Otherwise, the patient was in good health and had never suffered even temporarily from gout or rheumatism.

In the left ear there was ossification of the helix, with the exception of the lower and anterior portions, and ossification of the scaphoid fossa and the anterior root of the antihelix. The remaining portions of the auricle were normal or showed only a slight degree of hardening. In the right ear the disease was the same, only the ossification of the antihelix had not progressed as far. In the lower wall of the auditory canal, especially of the left ear, there were areas in the beginning portion which were as hard as bone.

No doubt Linsmayer's case was one of ossification. The analogy between the method of dissemination occurring in this case and in other cases previously reported and the time at which the malady appeared seems to indicate that ossification was present. The only other possibility might have been a chalk stone, such as is often found in the cartilage of the ear, but this usually appears at one side only and consists of a conical or flat deposit not larger than a pea. Furthermore, such patients usually show signs of gout in other parts of the body.

Linsmayer expressed the belief that the chilblains of earlier years might have been instrumental in the causation of the ossification in his case. He thought that chronic hyperemia of the ears due to vascular paralysis might have developed and so have brought about the changes described. Ossification and the formation of osteophytes are encouraged by chronic hyperemia in other parts of the body, as for instance in the dura mater.

In 1906, Haug [8] reported a case under the title of "So-Called Ossification of the Ear."

A laborer, aged 64, came to Haug for examination on account of defective hearing in the left ear. Examination showed an occlusion of the auditory passage by a plug of cerumen. The plug was removed, and the hearing improved. In connection with the examination, Haug found that the external ear was hard to the touch, whereas the right one was of normal consistency. On being questioned, the patient stated that thirty-two years previously he had suffered from frost-bite in the left ear, and that after the first painfulness of the inflammation had subsided the ear had become "leathery," numb and entirely stiff. Previous to that time he had never noticed any abnormalities in the ear, but since the occurrence of the foregoing changes he occasionally noticed that his sense of hearing was impaired on the left; each time the situation was relieved by a "physician who removed something from the ear." Gradually, however, in spite of the removal of these masses, the sense of hearing became less and less keen on the left. Otherwise, the ear gave him little or no trouble; even in the winter he experienced no sensations other than the "leathery" feeling.

The ear drum showed nothing unusual with the exception of a slight cloudiness. The auditory passage seemed to be a darker red than the right, especially in the cartilaginomembranous portions, but this might have been due to the irrigation. The rigidity described began in the ascending portion of the helix, extended throughout its entire extent and terminated immediately above the lobe in a spurlike process pointing downward toward the lobe. There was also a hardening over the scaphoid fossa and the entire antihelix. The deepest portion of the intercrural fossa had not been invaded.

From the inner portion of the antihelix the changes spread to the concha, but its inner portion showed normal cartilage. The antitragus and the spina helicis were also involved in the process. The tragus and the entrance to the meatus were free. There was no trace of hardening in the lobe.

The skin covered the cartilage throughout in completely normal fashion, without wrinkles at any point. The color was slightly abnormal, being somewhat yellowish in comparison to that of the other ear. The temperature of the two ears seemed to be the same.

After reporting the case, Haug discussed the possible etiology. He expressed the belief that the frost-bite induced permanent disturbances in the innervation of the skin of the auditory passage by way of the sweat glands in the ear. In this connection, paralysis of the vaso-constrictors probably also occurred, so that overstimulation of the vasodilatory functions produced a relative and an absolute increase in the production of cerumen.

Haug stated that he had observed this increased secretion of cerumen in an earlier case of frost-bite which was bilateral, and which did not result in permanent injury. At that time he did not assume an etiologic connection between the two, but after observing the case described the idea suggested itself. He thought that the color might also be due to the changes in the innervation and vascular pressure.

Muller [9] gave a brief general discussion in an open forum on ossification of the auricular cartilage. Although he did not report a case, he said that he had seen and studied two patients who had entered his clinic. On the basis of his study of these conditions, he came to the conclusion that they occurred with increasing frequency and extent with advancing age, and were to be observed chiefly in persons who were exposed to the extremes of weather.

Muller and also Burger looked on the sequelae of local frost-bite as of general importance in the pathogenesis of dis[illegible]of the cartilage, such as osteo-arthritis. They held that potential resi[illegible]al forces may be latent for several decades and may be the primary [illegible]ses of alterations in the cartilage.

Osler,[10] who was in the habit of making careful [illegible]servations on all conditions present in his patients, reported having seen three cases of calcification of the auricle. Mention was made of these cases particularly, as he was discussing the possible relationship of such calcification to gout. In these cases there was no gouty condition, and other possible etiologic factors were not considered.

Laskiewiez [11] reported the most authentic case on record, in which a constitutional disease was definitely diagnosed and was in immediate causal relationship to ossification. In a male, aged 49, this condition developed during the course of severe diabetes, and a history of previous injury by cold or traumatism could be excluded. The condition was bilateral and was limited to the upper half of the antihelix.

Gray [12] recorded an instance of bilateral calcareous infiltration following oto-hematoma. The injury producing the hemorrhage was sustained twenty years before the deposition was discovered. Such a case illustrates well the slow progress by which calcigerous metaplasia is accomplished. It is rather surprising to note that this is the only case reported which deals with subperichondrial hemorrhage as an etiologic factor.

In 1926, Martenstein [13] reported a case of ossification of the cartilage of the ear in a man 63 years of age. In this instance, ossification occurred forty-three years after injury due to frost-bite.

The idea that a tendency toward ossification may at times be inherent in the auricular cartilage is sponsored by Marobbio [14]. He described a perfectly symmetrical, bilateral, bony area in the fossae of the antihelix. The patient was a woman, aged 58, who was in good health and did not have a history of injury. Furthermore, she stated that as long as she could remember the areas of bony hardness described had been present in her ears. Roentgen examination revealed a typical bony structure.

Ekehorn [15] reported a thoroughly studied case from his own practice; he gave a résumé of the literature and discussed the causes, therapy and incidence. The following description of his case is of particular interest.

A man, aged 42, consulted Ekehorn on March 18, 1925, complaining of various disorders. Nothing definite could be determined concerning his ancestry, except that his father "had a blood disease." He had no sisters or brothers and was not married.

At the time of admission, he presented a healthy appearance, with bodily development and musculature equal to the average. The most noteworthy change observed was the condition of the auricles. Both auricles were as hard as bone throughout their [illegible] extent, with the exception of the lobes. The hardened portions were slightly nodulous to the touch, and were most pronounced in the tragus and the antitragus. On inspection, both auricles were found to present a normal picture with reference to form and relief, showing no signs of inflammatory processes or traumatic changes. Roentgen examination revealed deposits of calcium in the cartilages of both auricles, in especially large quantities in the antihelix and the antitragus. The deposits were partly cloudy and partly netlike, reminding one of spongiosa. There was chronic purulent otitis media on both sides. The patient was completely deaf in the left ear and partially so in the right. The deafness was of the obstructive type.

Unlike most of the other patients whose cases were reported in the literature, this patient suffered from disturbances in other parts of the body. For the past ten years he had been troubled with diffuse, noncharacteristic sensations in the skin of both legs; these difficulties showed a tendency to increase, and during the past several years pains in the muscles of the legs and the long bones also appeared. The pains were especially pronounced at night, and although they were not severe they suggested the possibility of syphilis, since no other nervous disturbance could be determined by careful objective examination. Roentgen examination revealed calcified veins in the lower parts of the legs, but, judging from the nature of the pains, there could be no connection between the two conditions. The reaction to exercise and rest was the exact opposite to that observed in cases of angiosclerotic dysbasia. Furthermore, lumbar puncture showed that there was an irritation of the meninges of the central nervous system, thus indicating that the difficulties described might be of central nervous origin. The strongest argument in favor of a syphilitic origin of the disturbances was the fact that the unpleasant sensations and pains in the head and legs decreased under antisyphilitic

treatment. Other arguments were: chronic, symmetrical, dermal ulcers on both legs during the patient's youth, the distended condition of the aorta, typical parenchymatous keratitis combined with anterior choroiditis during childhood; the residua of these diseases alone would justify a diagnosis of hereditary syphilis even though one did not take the other stigmas into consideration.

In his review of the literature, Ekehorn mentioned several cases that have already been reviewed in this paper, but in addition he mentioned some to which there has been no previous reference. The first of these was a case published by Wassmund in 1899.

Wassmund [16] was the first to examine by the x-rays a case of ossification of the ear. His patient was a man, aged 49, who came to the consulting room on account of a nodulated induration of the right ear, which he attributed to frost-bite. The change extended over about two-thirds of the scaphoid fossa and included also a small portion of the antihelix; the helix remained unossified.

Five cases of ossification of the auricle examined by the x-rays were reported by Lübbers [17] in 1912. In all five cases there was true ossification of the cartilage with a formation of spongiosa and fibrous medullary substance; in most cases, the ossification was confined to the edge and the tip of the helix. One of the patients was 43 years of age, the others were 60 or older; all were men.

In three cases frost-bite was looked on as the cause; in one case the patient did not know of a cause, as he had never suffered from chilblains or from traumatism. In the fifth case, the condition was found in a cadaver, and etiologic data could not be found.

The authors who reported the foregoing cases were of the opinion that the condition was very rare.

Fraenkel [18] expressed an entirely different opinion. During the course of his practice, he accidentally noticed that in people of advancing age the ears often showed small and sometimes large areas in which the cartilage was more or less hard and rigid. This discovery aroused his professional curiosity, and he made a series of roentgenologic examinations of seventy-five persons, fifty-two men and twenty-three women, ranging in age from 45 to 89 years. Among these seventy-five persons there were fifteen who showed more or less extensive calcification or ossification in the cartilage of the auricle; thirteen of these were men and two were women.

The results obtained by Fraenkel do not agree with the opinions of other authors concerning the infrequency of the disorder. According to Lübbers, this difference of opinion might be explained by the degree of ossification discovered. In his discussion of the results of his roentgenologic study, Fraenkel stated clearly that in only a few of the fifteen cases did the hardened areas cause a clinical disturbance. In ten of

his cases the ossifications were no larger than a lentil or a mustard seed. In the cases in which they were observed in both ears, they were entirely symmetrical. In nine of the fifteen cases the pathologic condition was calcification of the cartilage; in three cases there was ossification with a formation of typical spongiosa, and in three additional cases the two were present simultaneously. The larger foci were located chiefly in the helix and the antihelix, while the smaller ones were found in those two portions exclusively.

According to Fraenkel, therefore, the following factors come into consideration: (1) advanced age, (2) exposure to low temperatures and (3) the earlier presence of hematoma auris.

Fraenkel was distinctly opposed to the idea expressed by some authors that general nutritional disturbances of any sort may induce deposits of calcium in the auricles. On the other hand, he was inclined to admit that minor traumatisms to the lobes of the ears, such as awkward position during sleep, may be of some importance.

I shall report an additional case.

Mr. T., aged 82, came to me for relief from impacted cerumen. Unusual features of the left auricle were apparent on inspection. This ear was larger than the right; it protruded more prominently and was slightly bluish gray. On palpation, the pinna, with the exception of the lobe, was hard and thick and moved as one mass. The skin was not unusual, except for color. Comparative measurements of the two ears were as follows: breadth of attachment of the left, 20 mm.; of the right, 8 mm.; greatest diameter on the left, 8 cm.; on the right, 7.5 cm.; thickness on the left, 9 mm.; on the right, 7.5 mm. The left auricle was bent into a marked concavity as compared with the right. The circumference of the external canal was only about two-thirds the size of the right. The ear drums were of normal appearance. Tests revealed good hearing in both ears, but it was better in the left, probably owing to the greater concavity on that side.

The condition had been present for six years. Careful questioning as to habits, injuries and infections gave no clue to the etiology.

The patient was a retired attorney; he had always led a sedentary life. For many years he had followed the practice of having annual physical examinations, and he gave records of normal findings in regard to the blood cells, blood pressure, chemical content of the blood, Wassermann test and function of the kidney and the heart. Except for asthma twenty years previously, he had not been ill.

He was in excellent health for his age and had no symptoms of disease. There were only two subjective findings in the case, namely, a feeling of warmth in the affected ear and an inability to lie on the left side because of the discomfort from pressure on the ear. Roentgen examination revealed a large area of calcification, 3 cm. in its greatest diameter. This area was oval and occupied the most anterior superior area of the pinna, completely filling the fossa of the antihelix and extending from the upper border of the external meatus to the helix. A second area of calcification paralleled the posterior border and resembled a miniature sacrum and coccyx in shape and segmentation. Five distinct segments resembling articulations were seen. In the antihelix, three distinct areas of calcification were present. In all of these areas the periphery was denser than the center, and a

reticular structure was seen, giving some weight for an interpretation in favor of the formation of spongy bone. None of these distinct areas gave an irregular outline to the skin, nor could they be detected by palpation.

ETIOLOGY

The etiology of calcigerous metaplasia of the auricular cartilage seems to be embraced under three headings: (1) injury, (2) infection and (3) senile changes. Little is known of the first cause. The theory that latent forces are stored in tissue for years only to be aroused by some unidentified substance or circumstance is not to be refuted, because the theory is made to fit the case, and, furthermore, its counterpart is found in the etiology of malignant neoplasm and even in otosclerosis. It is significant that the injuries seem to have been produced by cold. The case that followed infection seems to be clearcut and needs no hypothetical background, although the frequency of infections and the infrequency of ossification are remarkable. That changes due to senility may rarely cause such a condition opens the whole subject of degenerative processes for discussion. The variety of opinions—some based on fact and others on pure theory—is so great as to give none the importance of a leading rôle. Articles dealing with this phase of the subject are given in references 19 to 37. Study of these does not lead one to a definite conclusion, and the theories advanced are too variable for consideration in this article.

PATHOLOGY

According to Muller,[9] the histologic specimens showed as the first stage a circumscribed necrosis of the cartilage with beginning calcification at the periphery and detritus without any pronounced structure in the central region. In the more remote periphery there was partial necrosis of the cartilaginous cells. The sequelae of necrosis of the cartilage are given as: The connective tissue is rich in vessels emanating from the perichondrium, while the cartilage separates into two layers. Subsequently, there are microscopic pictures of the broad formation of bone, with completely developed medullary spaces. The enchondral form of neoplastic ossification and the cartilaginous form of metaplastic ossification occur here. The changes consist partially of increasing ossification of the residual portions of the cartilage with encroaching proliferation of perichondral tissue rich in cells and partly of cartilage cells in various stages of transition from cartilage to bone.

SUMMARY

1. An attempt has been made to review all of the cases of calcigerous metaplasia of the auricular cartilage reported.

2. One new case has been reported.

3. The coincidence of senility and frost-bite in earlier life is so frequent as to suggest a direct relationship.

4. The descriptive title "Calcigerous Metaplasia of the Auricular Cartilage" is used because it describes the changes occurring whether the deposit laid down assumes the typical formation of bony tissue or merely an infiltration of calcium.

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Clinical Notes

A NEW BIPOLAR ELECTRODE FOR COAGULATION OF THE TONSILS*

EINAR A. SUNDE, M.D., BROOKLYN

Coagulation of the tonsils is gaining in use in spite of some well founded objections. That it eliminates the danger of abscess of the lungs or deep cervical infection cannot be safely asserted until many more cases have been recorded. According to Dan McKenzie, of London, true hemophilia is a contraindication to its use. Hemorrhages have been reported in nonbleeders following the separation of the coagulated tissue. The procedure cannot be used in children, therefore automatically ruling out the greater percentage of subjects. It requires several applications, each followed by some reaction. No assurance can be given of complete removal within a definite time.

Its greatest use is found in cases in which the patients cannot or will not spare the time to go to the hospital and remain away from their work for the one or two weeks necessary when operation is performed. In cases regarded as inoperable, and it must be admitted that these are extremely few, it may be said to be useful.

In the removal of the tonsillar tags left after operation, the method is invaluable.

The most common method of application is the use of the bipolar d'Arsonval current with the large neutral terminal plate placed on the back of the neck and an active needle electrode to coagulate the tonsil.

The second, less commonly used method is desiccation with the monopolar needle electrode, one of the higher voltage Oudin or Tesla currents being used. A third method, fulguration, was given up years ago.

The biterminal method is fussy; the plate has to be adjusted carefully in close contact with the skin to avoid unpleasant sparking, and must be large enough so that burns do not result. The volume of current used corresponds to from 2,500 to 3,000 milliamperes, with a metal short circuit across the terminals.

The desiccation method is easy to manipulate, but the application is more unpleasant to the patient, possibly owing to the higher voltage used. The amount of current used is uncertain, being measured roughly by the length of the spark drawn from the electrode to a coin held in the operator's fingers. During the application, sparks may be drawn from the patient if his body becomes grounded on any metal or on the operator's finger-tips. It also requires a greater number of treatments to destroy a tonsil by desiccation than by coagulation.

THE INSTRUMENT

I have devised an electrode, the use of which obviates these various objections. It is a biterminal electrode, consisting of two wires, pointed at the tips, passing through a carrier of dielectric composition. The wires are 1 inch apart at the

* Submitted for publication, Dec. 3, 1930.

butt, tapering down to a separation of about ¼ inch at the active end. The protruding active tips are curved to act as a double hook, and the points also converge to a slight degree. The ends at the butt are connected to the two terminals of the d'Arsonval coil by the ordinary high frequency cords. Thus two active electrodes are used in coagulating the tissue.

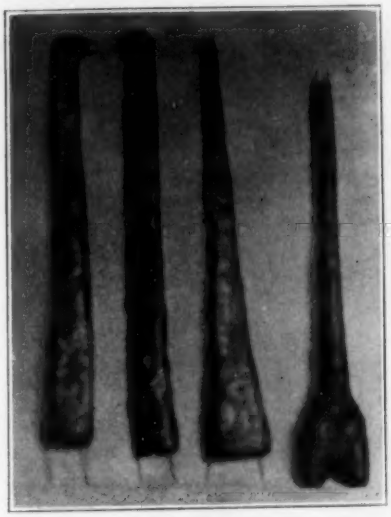

Figure 1

Figure 2

Fig. 1.—The electrode.

Fig. 2.—The tip of the electrode, showing the curved ends of the wires.

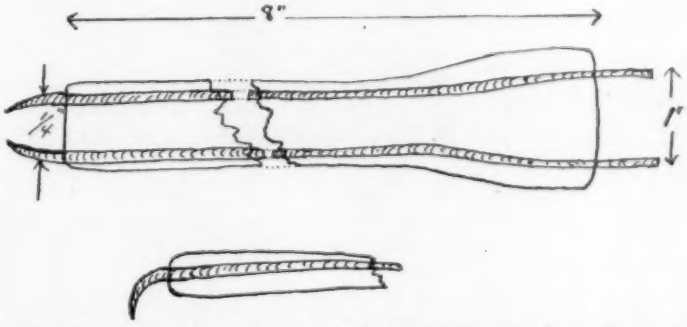

Fig. 3.—Diagrammatic drawing of the electrode as seen from the top. No. 18 rust-proof wire was used. The wire is shown running through plastic wood. The lower drawing is of the tip of the electrode, as seen at the side, showing the ends of the wire.

The points are inserted into the tonsil (after anesthetization) in the usual manner, and the current is turned on by a foot switch. The area of coagulation does not extend to an unknown degree, but is sharply limited to the gap between the tips, and around them to a moderate degree. It does not extend an apprecia-

ble distance beyond the tips buried in the tissue; in other words, the current is directional and its greatest intensity is confined to a straight line between the two active tips.

The electrode was first tried out on a piece of meat to ascertain the proper coagulating current. This was found to be between 700 and 750 milliamperes,

Fig. 4.—Area of coagulation in meat.

measured with a dead short. This compares with the 2,500 to 3,000 milliamperes used in the former method of coagulation. The time of application is the same as heretofore used—from one to two seconds.

It was also thought that sparking would occur between the terminals, but on experiment it was found that with the wires ¼ inch apart it required a current of 3,000 milliamperes to cause a spark to jump the gap. As only 750 milliamperes are used during the operation, the margin is sufficient to prevent sparking.

COMMENT

This method of coagulation, which might be termed the diathermy gap or arc method, is easy to manipulate; the patient does not even need to remove his collar. There is no danger of burns or sparking from a neutral electrode. There is no possibility of drawing sparks from the patient, as he is at ground potential throughout. The depth of coagulation is more accurately determined, as there is little or no coagulation beyond the end of the gap; thus the depth of coagulation is roughly regulated by the depth of the tips of the electrode. The reaction following a treatment is the same as that following ordinary coagulation. The reaction is always less if the pillars have not been affected.

925 Union Street.

A SCOURING APPARATUS FOR THE CLEANSING OF CAVITIES, SUCH AS THE PARANASAL AIR CELLS*

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If the apparatus presented is the result of an invention, it is because the old adage about necessity and invention is true. Several months ago, in an attempt to check up on the observations in transillumination, particularly of the maxillary air cells, I determined to irrigate every antrum that suggested pathologic contents. As a consequence, I suddenly had a large number of cases of chronic empyema that required several or many irrigations.

To those who do not practice rhinology this may not seem unpleasant, but to those who treat patients with diseases of the sinuses it means disagreeable activi-

* Submitted for publication, Feb. 10, 1931.

* Presented before the Homeopathic Medical Society of the County of Philadelphia, Oct. 9, 1930.

ties in connection with sterilizer and wash room, many wet rubber aprons, soiled clothing—for both operator and patient—towels, syringes, basins, rubber tubes and a galaxy of other features that make one's practice a task and not a joy.

I had noticed for years that the final attempt to blow washing solution from an antrum with air often causes an additional flow of accumulated matter and I had learned to accept this as part of the technic of washing. It was the thought of simplifying the washing and, at the same time, of making use of air pressure that led me to design the apparatus shown in figure 1.

The apparatus consists of a readily movable stand on ball-bearing wheels. At the top of the stand there is a cylindrical metal container so proportioned as to admit a standard 1 or 2 liter wash bottle. At the base of the metal cylinder is a 25 watt incandescent light which has been proved to disseminate sufficient

Fig. 1.—Scouring apparatus for the cleansing of cavities.

heat to maintain a temperature of from 100 to 105 F. within the filled wash bottle. The bottle is capped with a metal cover perforated by two metal tubes: a short inlet tube, and an outlet tube originating near the bottom of the jar. Any air pressure applied to the inlet tube causes a solution within the jar to be expelled through the outlet tube. Connecting these two tubes, however, and tapping the inlet before entering the jar and the outlet after it leaves the jar, is a small shunt tube controlled by a variable by-pass valve. Through this any desired proportion of air can be injected and admixed with the outflowing solution.

Air pressure is supplied to the inlet tube by either building pressure or an electric air pump, and to the outlet tube is attached a stout rubber hose which terminates in the male member of a universal telescopic coupling.

To demonstrate this apparatus, I have had blown a glass model of a maxillary antrum. It has two openings; one, which is fitted with a small rubber stopper,

represents the usual site of puncture of the antrum; the other, the natural opening of an antrum. When a common Lichwicz needle is plunged through the rubber stopper, a rubber hose attached to the upper opening to conduct overflow solution safely into a waste basin and the pump started with the shunt valve turned toward "all water," the solution flows gently or swiftly, according to the pressure, through the "antrum" and out of the natural opening. One could hardly imagine such a flow disturbing tenacious mucopus or septic matter behind a bony trabeculation.

When, however, the valve is turned so as to add air to the washing solution a distinct "scouring" action occurs within the antrum. It is not conceivable that any discharge could withstand this action. If desired, the valve can be turned still farther, so that nothing but air is blown through the apparatus. There is no commotion; no water is splashed or dropped and not even the operator's fingers are soiled.

Fig. 2.—Pilling-Hollis office unit containing the apparatus.

I have had all of my irrigating instruments for the antrum, frontal, ethmoid and sphenoid sinuses, middle ear, attic, etc., made to fit the universal telescopic coupling, and I have been more than pleased with the scope of possibilities of this apparatus.

Incidentally, I can now wash an epitympanum through a high perforation under direct vision and without the help of an assistant. After its use, the apparatus can be readily rolled to the nearest sterilizing room and the hose properly cared for. It can also be removed from room to room for use; the electric wire can be plugged into a socket for the maintenance of continued warmth.

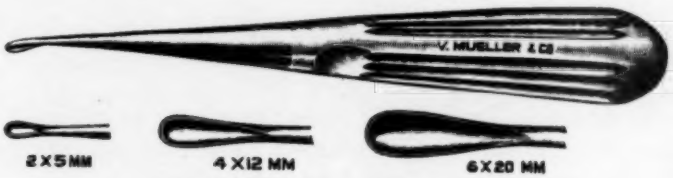
A shut-off valve in the irrigating tube prevents siphonage, and a shield at the distal end of the tube prevents the outflow of waste water from running up (or down) the tube.

1930 Chestnut Street.

AN IMPROVED CURET FOR OPERATION ON THE MASTOID*

CHARLES NELSON SPRATT, M.D., MINNEAPOLIS

Among the instruments employed for operation on the mastoid by my father, the late Dr. C. J. Spratt, was one that he purchased in Berlin in 1884. The instrument has a pear-shaped bowl and thin edges. It was made by Detert and is listed in his catalogue for 1888 as a Kuster model. As the handle is somewhat small, it does not afford a firm grasp when the curet is used as a rotary cutting instrument. At my suggestion, V. Mueller & Company combined this bowl with the handle used on my curet. This new instrument is suggested in three sizes,



The improved curet for operations on the mastoid.

2 by 5, 4 by 12 and 6 by 20 mm., as being sufficient for practically all work on the mastoid. The curet may be used as a rotary cutter or as a scraping instrument. Owing to the sharp cutting edge, it must be treated with respect, and not thrown about among other instruments in the sterilizer by the attendants in the operating room. A knifelike edge may be maintained by the application of a small oil stone lengthwise on the inner edge of the bowl. By extending the bowl to the shank, it can easily be kept clean.

* Submitted for publication, Feb. 13, 1931.

Progress in Otolaryngology

A Summary of the Bibliographic Material Available in the Field of Otolaryngology for 1930

PROGRESSIVE DEAFNESS, OTOSCLEROSIS AND DISEASES OF THE LABYRINTH

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In the past year Lange [1] has given the results of his study of the early pathologic changes in otosclerosis. The material used consisted of sixty-six temporal bones from forty-five patients.

The site of the foci was noted as follows: oval window alone, twenty-two; both windows, seven, and round window alone, four. In only two of the forty-five cases were the windows free. Of the twenty-one cases in which both sides were examined, twenty showed symmetrical areas of disease on both sides.

For the study of the early stages, Lange chose not the manifest foci on the promontory, but other smaller areas in the rest of the labyrinth capsule. He stated that in the latter situation the process differs considerably from that on the promontory, as at the windows hypertrophy is a prominent feature. The enchondral bone here is very thin and receives a better supply of blood from the surface vessels. In the other parts of the capsule, hypertrophy is not possible on account of the other surrounding bone. With hematoxylin-eosin stain, the blue-staining diseased bone is not always sharply defined from the rest of the bone, but often merges gradually into it. In an area in which sharply defined foci are present, it is to be noted that the irregularity of outline corresponds with the branches of the vessel. In many areas the boundary line goes through the interglobular spaces, showing that there is a proliferation rather than an absorption. Where the process is active, giant cells may be found at the edge, though not commonly. Manasse could not find them.

Normally, in the endochondral bone of the labyrinth the bone cells are scarce in comparison with ordinary skeletal bone, and the long processes are not well seen. Otosclerotic foci, on the other hand, are rich in cells. In the more indistinct areas, cells are scarce until blood vessels

1. Lange, W.: Ztschr. f. Hals.-, Nasen- u. Ohrenh. **25**:1, 1930.

appear, when numerous cells can be seen. These new cells do not occupy the same spaces as the old ones did, but they may sometimes be seen side by side with them. They often lie in rows at the boundary line. The number of cells increases with the occurrence of marrow spaces and the multiplication of the blood vessels. When the vessels are numerous, well stained nuclei are seen even in the normal, surrounding pink-stained bone. This means that active changes of the bone are brought about by altered metabolism.

Lange distinguished three stages: an early stage in which the changes are mainly degenerative; a cartilage stage and a bone stage. It is in the cartilage stage that active growth occurs. It begins with the appearance of new vessels. New active changes occur. New nuclei appear in the areas previously almost free from them. These nuclei are probably derived from cartilage residue. They form the ground substance for the chondroid tissue of the stage. It is possible that some of them arise from the blood vessels. The bone stage is characterized by numerous osteoblasts arranged in rows, which produce the change into bone composed in regular lamellae. It is somewhat like endochondral bone, but without the interglobular spaces. In this stage the cell holes in the bone are noticeably empty. Some foci have compact bone; others have large marrow spaces containing fat, while others contain large vessels or fibrous marrow.

Most of Lange's sections were stained with hematoxylin-eosin after fixation in formaldehyde. He also used thionine-phosphotungstate and thionintrinitrophenolate (picrate). These stains show the bone cells more distinctly. Staining with thionine shows that in areas of gradual change the bone cells lose their processes and disappear. Only in the final red-staining bone are processes found again. In nineteen of his forty-five cases, Lange found blue-staining bone in the semicircular canals; of these, five were typical foci, while fourteen others were still in the first or early stage.

Lange agrees with Eckert-Moebius and Doederlein that the first stage is degenerative, as opposed to O. Mayer, who thinks it new bone formation. He believes that otosclerosis has nothing to do with osteomalacia or rickets, and that it is not inflammatory.

Weber [2] attempted to show that the bone picture in otosclerosis is identical with that in localized osteodystrophia fibrosa. Both diseases follow the same course, though they do not necessarily have the same etiology. Both show a degenerative and a reactive reparative process. Irritation shows itself by resorption of bone or cartilage followed by deposition of young mesenchymal tissue, which in turn becomes fibrous bone. Weber regards otosclerosis as a pseudotumor resulting from a

2. Weber, Moritz: Tr. Am. Otol. Soc., 1930, p. 55.

maldifferentiation that may originate from a faulty rudiment, though not necessarily. A secondary dystrophic disturbance may bring about the same result.

Weber discussed the possibility of producing otosclerosis experimentally. It would require an animal with a capsule of the labyrinth similar to that in man. Otosclerosis is known to appear simultaneously with osteitis fibrosa or osteogenesis imperfecta, and it might be possible to duplicate these conditions. Osteodystrophia can be produced in dogs on a purified diet low in calcium and completely lacking in vitamin D. In intra-uterine scurvy, changes of the bone similar to those of osteodystrophia and osteogenesis imperfecta are found. There is a peculiar callus at the fractures that resembles closely the changes in otosclerosis.

In another paper Weber [3] reported on osteogenesis imperfecta of the labyrinth capsule. The material studied was from a girl 2 years of age. The only cases previously described were by Nager and Fisher. This is the first case of congenital osteogenesis imperfecta recorded.

The endosteal bone is of the usual thickness and is separated from the endochondral bone by a cement line. The intercellular substance shows irregularity and patchy staining. In places there are fibrous longitudinal strands. There is no lamellar structure.

The endochondral bone here has specially large marrow spaces; in fact, most of the area corresponding with the endochondral layer is represented by marrow spaces. On the edge of these cavities are islets of cartilage which here and there show cartilage cells. Some of these islets are surrounded by osteoid tissue. In the center of the solid part is a homogeneous cartilage ground substance in which large cartilage cells are scattered. The edges of this mass are jagged, and the indentations are filled with fiber bone. There is no trace of lamellar structure, and the intercellular substance is irregularly stained. With hematoxylin-eosin the bone stains mostly blue, while the normal bone is pink. Toward the edge of the marrow, this staining is dark blue, and the bone here contains cells of various shapes. None of them have processes like ordinary bone cells. This bone appears to be an intermediate stage between cartilage and bone. The marrow is lymphoid without fat cells. Neither osteoblasts nor osteoclasts are present around the edges.

The periosteal bone is of about normal thickness. Nearer the periosteum the bone centers are in the form of small islets; these are at first composed of fibroblastic osteoid tissue, which gradually hardens through calcification. This bone is different from normal bone. The intercellular substance is a fibrous network. The bone cells retain their original form; they are surrounded by a clear space and have no processes. There is no lamellar bone, and no osteoclasts are seen.

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3. Weber, Moritz: Ztschr. f. Hals-, Nasen- u. Ohrenh. **25**:345, 1930.

Cartilage remains are found in the usual places, and the intercellular substance is irregularly calcified. There is no surrounding lamellar bone.

The ossicles show abnormally large marrow spaces containing a few isolated shreds of bone. The shell is of poorly formed fiber bone.

Wittmaack [4] attempted to produce otosclerosis in fowls by blocking the veins of the neck and foramen magnum, thus producing passive congestion of the labyrinth. Microscopic examination showed changes resembling those of otosclerosis.

In discussing this paper, Mayer denied that the changes resembled those of otosclerosis, and stated that old fowls show similar bone changes anyway.

Turning from the pathologic aspect of otosclerosis to the metabolic, there is a study by Gottlieb [5] on pancreatic function in nine cases of otosclerosis and twelve cases of nerve deafness. The examinations included urinalysis, estimation of blood sugar and estimation of trypsin, amylopsin and steapsin in the duodenal contents.

In most of the cases of otosclerosis there was a definite reduction of tryptic activity. The amylolytic function was also lowered, though in a lesser degree. In several of these cases the blood sugar was higher than normal. In twenty of the cases tests of the duodenal contents were made. In six the results were normal, and in the remaining fourteen there was definite lowering of digestive function. "This consistent finding suggests the possibility that the defect in pancreatic digestion may stand in causal relation to the deterioration in hearing." In one of the six cases in which there was normal digestion there was otosclerosis; in one, tumor of the brain; in one, no contributing disease, and in three disease of the gallbladder. Mayer stated that in most cases of disease of the gallbladder there is some impairment of hearing. In five of the cases the figures for blood sugar were above the normal, and in two cases there was sugar in the urine. Gottlieb also stated that deafness is the rule in diabetes.

Four patients with nerve deafness were treated with pancreatic extract, with considerable improvement. When the treatment was discontinued, the hearing became worse, and it improved again when the treatment was recommenced.

In an original and stimulating paper on otosclerosis, Louis Mirvish [6] supported the view that this disease is a metabolic disorder. He reviewed the present state of knowledge, pointing out the frequency of gonadal deficiency, low calcium content and cholesterol metabolism, etc. Pre-

4. Wittmaack, K.: Acta oto-laryng. **14**:228, 1930.
5. Gottlieb, M. J.: Laryngoscope **40**:85, 1930.
6. Mirvish, Louis: J. Laryng. & Otol. **45**:449, 1930.

vious work by Mirvish and Bosman had established the fact that extract of ovary injected into animals produces a fall in blood calcium. They found a substance which is present in extracts of ovary, suprarenal cortex and probably of testis and which reduces blood calcium both in rabbits and man. More recently, Mirvish had found such a substance present in cereals, especially oatmeal. This substance has the effect of neutralizing vitamin D.

Mirvish considers that there is a close analogy between rickets, osteomalacia and otosclerosis, and that similar treatment should be used for all three. There is some evidence that the occurrence of osteomalacia is due in part to some activity of the ovary. Calcovarin seems to produce its effect on the blood calcium through the parathyroid. Mellanby has shown that the anticalcifying effect of oatmeal could be neutralized by a sufficiency of vitamin D. Vitamin D is incapable of raising the blood calcium in the absence of the parathyroids. Calcovarin neutralizes the parathyroid hormone and produces low blood calcium. This forms the basis of the pathology of rickets, osteomalacia and otosclerosis. If this idea is followed, treatment of otosclerosis should be removal of the gonads or administration of parathyroid.

Mirvish observed and treated three patients with otosclerosis in the manner discussed in the preceding paragraph. The periods of observation varied from one to three years. In order to avoid the fallacies of one or two tests for hearing, he induced the patients to carry out regular tests with the same object and to make a note, so that after a few months an accurate idea of the patient's average acuity of hearing could be obtained. The patients were treated with subcutaneous injections of 15 units of parathyroid extract-Collip twice weekly. All three patients had cases of typical advanced otosclerosis, and all showed marked improvement lasting over a long period.

After estimating the calcium content of the serum and the acid-base balance in otosclerosis, Hornicek [7] agreed with the results of Behrendt and Berberich. The majority of the cases showed lowering of the calcium and shrinking of the reserve of alkali.

Fowler [8] reported fifty-eight cases of otosclerosis that he had had under observation in the preceding two years. In every case estimations of the blood calcium, phosphorus and cholesterol were made. His results differed from those of many other observers in that the calcium content of the blood was practically identical with that in forty-four normal controls; the normal content seems to be from 9 to 11 mg. per hundred cubic centimeters. For phosphorus the normal seems to be from 3 to 4 mg. per hundred cubic centimeters in children and from 2.5 to 4.5

7. Hornicek, V.: Zentralbl. f. Ohrenh. **32**:318, 1930.
8. Fowler, E. P.: Tr. Am. Otol. Soc., 1930, p. 39.

in adults. He stated that it appears certain that in established cases of otosclerosis no changes of consequence can be detected in the calcium-phosphorus variations of the blood. In potential or incipient cases of otosclerosis, it is possible that something may yet be discovered, but there is difficulty in diagnosing such cases.

Jannuzzi [9] carried out some work to determine the blood groupings of all the available members of five families, in each of which there were a number of deaf persons suffering from otosclerosis. He found that all the deaf members of a given family belonged to the same blood group. In one family, all were in group 2; in another, all were in group 4, and in the remaining three families, all of the deaf members were in group 3. The author considered that these data confirm the presence of the hereditary tendency in otosclerosis.

MacLeod Yearsley [10] suggested that otosclerosis is due to slow poisoning of the cortical cells from chronic intestinal intoxication. He stated that every case shows some of the cardinal signs of familial chronic intoxication. The changes in the capsule of the labyrinth are explained as trophic alterations rather than the primary cause of the deafness. The changes in the brain are stated to be due to precipitation of altered protein in the pericapillary lymphatics of the temporosphenoidal lobe.

Indications for treatment are disinfection of the colon and administration of vaccines cultivated from the intestine. Yearsley also uses the reeducation method of Zuend-Burguet.

In a study of a hundred otosclerotic families, Davenport [11] reported on the family trees from those families in which both parents had had otosclerosis. The characteristic of simple recessive traits is that when they are present in both parents, the children nearly always show those traits. This is borne out by the charts of these families in which the children are almost invariably affected.

Davis [12] gave an analysis of 163 consecutive cases of deafness from the practice of Dr. G. M. Coates; of these, there were 109 cases of progressive deafness; thirty-eight of perceptive deafness, sixteen of conductive deafness and none of otosclerosis. It is somewhat surprising that when there were so many cases of progressive deafness none was diagnosed as otosclerosis. However, the personal factor must enter largely in such a classification. In the group with progressive deafness another otologist might classify some cases as otosclerosis and others as nerve deafness.

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9. Jannuzzi, S.: Arch. ital. di otol. **40**:499, 1929.
10. Yearsley, MacLeod: Practitioner **122**:348 (June) 1929.
11. Davenport, C.: Tr. Am. Otol. Soc., 1930, p. 48.
12. Davis, J. E.: Laryngoscope **41**:20, 1930.

Nash,[13] writing on otosclerosis, discussed the etiology, etc. He laid stress on the fact that when a diagnosis of otosclerosis, is made there must be progressive deafness, the Bezold triad and a normal middle ear and tube. Without these signs, a definite diagnosis can hardly be made. The Bezold triad, of course, depends on partial or complete ankylosis of the stapes, and hence many early cases must necessarily be missed. In fact, as Fowler remarked, there is no means of diagnosing early cases.

Nash added an analysis of 1,000 cases of deafness from various causes. The frequency of the conditions is as follows: middle ear deafness, 77 per cent; uncomplicated tubal deafness, 4 per cent; otosclerosis, 5 per cent; otosclerosis with nerve deafness, 0.7 per cent, and nerve deafness, 9 per cent.

There were sixty-four cases of otosclerosis, in seven of which there was nerve deafness as well. Of these sixty-four patients, 47 per cent were males and 53 per cent females. In 100 per cent of the cases there was a history of progressive deafness; in 48 per cent, a positive family history; in 100 per cent, a Bezold triad and in 100 per cent, normal middle ears; in 65 per cent the onset occurred at puberty, pregnancy or the menopause. Ninety-four per cent of the cases were bilateral; tinnitus was present in 76 per cent, paracusis in 31 per cent, diminution of tickle reflex in 86 per cent and dizziness in 4 per cent. Most of these cases were observed for periods varying from two to ten years.

In this series there were twenty-six cases of chronic catarrhal otitis which over a period of years had assumed many of the characteristics of otosclerosis. These patients formerly had presented signs and symptoms of closure of the eustachian tube and retraction and rigidity of the drum, and they had been treated by inflation and otomassage. Years later in many of them an unusually permeable tube and a drum that was either slightly retracted or normally developed. A careful distinction should be made between this type and otosclerosis.

In the past year Sourdille[14] has revived interest in the idea of improving the hearing in otosclerosis by making an artificial fenestra through the external semicircular canal. Something of the same sort was tried some years ago by Bárány, Jenkins and others.

Sourdille operates in two stages. In the first, the middle ear is opened from the antrum, and the external semicircular canal is exposed. The posterior meatal wall is carefully separated from the bone. The tympanic membrane is separated from the tympanic ring in its postero-superior part, and the bridge is removed. The head of the malleus is

13. Nash, C. Stewart: Ann. Otol., Rhin. & Laryng. **39**:769, 1930.

14. Sourdille, Maurice: Ann. d. mal. d l'oreille, du larynx **49**:10 (Jan.) 1930; J. Laryng. & Otol. **45**:601, 1930.

extracted by dividing the neck. The incus is also removed. Next, a thin flap of skin is cut from the posterosuperior wall of the meatus and laid over the external semicircular canal. The wound is packed and allowed to heal. The important point is that the cavity of the middle ear is now shut off from the region of the semicircular canal.

After four months, the wound is reopened, and a flap is outlined from the wall covering the canal and turned forward to expose the prominence of the semicircular canal. The latter is then rubbed down with specially designed scrapers until the endosteum is exposed. The flap is replaced and the wound allowed to heal.

The important points of the operation are: 1. The site of choice is the external semicircular canal, as this part can be made extratympanic. 2. The canal must be opened by gentle rubbing so as not to disturb the contents. 3. The epidermic flap must be thin. The placing and fixing of it is the most important part of the whole operation. 4. In the second operation, no matter how thin the osseous layer is, no improvement in hearing takes place until it is actually penetrated. At that point the patient feels dizziness for a few minutes, after which the hearing is immediately improved. The recovery of hearing coincides with the loss of a few drops of perilymph.

After the operation the improvement in hearing diminishes rapidly and may disappear by the fifth day. The hearing gradually improves again as the epidermic flap heals and becomes thin.

So far, Sourdille's results have been encouraging. He had operated on fourteen patients at the time of writing.

DISEASES OF THE LABYRINTH

Wittmaack [15] discussed the so-called Ménière syndrome and reported the case of a colleague, aged 68, who had suffered for a year or two from severe attacks of giddiness. One ear was deaf, but the other was almost normal. Wittmaack saw the patient during an attack, and he noticed that there was marked nystagmus to the affected side. The patient died a short time afterward, and Wittmaack had the opportunity of examining the temporal bone. The vestibular apparatus was found to be practically normal, but the aqueduct of the cochlea was full of small concretions. The cochlea contained a neurofibroma which almost filled the scala tympani but did not block the aqueduct.

Wittmaack expressed the belief that the attacks were due to the blocking of the aqueduct by the concretions. Both the perilymph and endolymph are probably partially secreted in the labyrinth and flow through toward the aqueducts. Experimentally, it has been known that

15. Wittmaack, K.: Arch. f. Ohrenh-, Nasen- u. Kehlkopfh. **124**:177, 1930.

raising the intralabyrinthine pressure produces nystagmus to the same side. The neurofibroma probably had little to do with the attacks.

Sommer and Savitt [16] reported the case of a woman who complained of dizziness and tinnitus accompanied by nausea and vomiting. At first there was no nystagmus, though falling was frequent. A slight nystagmus appeared later. Nystagmus could be induced by inclining the head sharply to the left (affected side). The caloric reaction was normal on the right side; nystagmus and dizziness were not produced on the left side, but there were falling and pointing deviation to the left. The galvanic response was slightly better on the left than on the right. The interesting feature of the case was the dissociation of the labyrinthine reaction. Syphilis and other general conditions could be definitely excluded.

The symptoms were improved by the administration of iodides and chloretone.

Sorsby [17] has written an interesting and well documented study of Beethoven's deafness. Beethoven's own notes, as well as the numerous references in contemporary literature, enable one to form a fairly accurate clinical picture of the condition. From Beethoven's own description, it is evident that the first noticeable impairment of hearing was in the upper tones, and this was followed by involvement of the whole tone scale. There was no history of suppuration of the middle ear or catarrh.

Many theories have been advanced to explain Beethoven's deafness. Several authors attributed it to syphilis. This view was based on the assumption that otosclerosis and cirrhosis of the liver were due to syphilis. The clinical course of the deafness was unlike that due to syphilis, and it is now thought that syphilis is not so important a factor in cirrhosis as was formerly imagined.

Suppuration of the middle ear or catarrh are rendered unlikely by the absence of a history of such a condition and the fact that the drum heads were normal after death. The cochlea was inspected at autopsy and appeared to be normal, except that it was slightly reddish. Whether the stapes were ankylosed or not was not mentioned.

Beethoven had suffered all his life from extremely severe gastrointestinal disturbances, which would be enough to account for the cirrhosis and also for toxic degeneration of the auditory nerves.

Reviewing the evidence as a whole, the author concluded that Beethoven's deafness was of that indeterminate type in which all the elements were affected, and that it was of a mixed middle and inner ear type.

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16. Sommer, I., and Savitt, L.: Laryngoscope **40**:558, 1930.
17. Sorsby, M.: J. Laryng. & Otol. **45**:529, 1930.

BIRTH TRAUMA

Albrecht [18] read a paper in Basel on the examination of the temporal bone of eighty stillborn children with reference to injury received at birth. The 160 ears were cut in serial sections. Hemorrhages were frequently found in the perilymph of both the vestibule and the cochlea. The endolymphatic spaces were unaffected. One of the commonest situations for hemorrhage was at the porus acusticus, where the vessels and nerves enter the modiolus. In severe cases there were hemorrhages in the spiral ganglion. Blood was frequently found in the middle ear, but this probably does no harm in cases in which normal development of the mucosa has taken place. When the mucosa is still embryonic, it is probable that a reactive swelling occurs which predisposes the new-born to otitis.

METALLIC POISONING

Preobrajensky [19] stated that numerous isolated cases of toxic lesions of the ear caused by lead, mercury and silver have been reported. According to some Russian observers, industrial deafness occurs in about from 25 to 30 per cent of lead workers.

Preobrajensky carried out three series of experiments in white mice with lead, mercury and silver. Amounts sufficient to cause chronic poisoning were injected at intervals. The animals were killed. The brain and temporal bones were fixed at once and later examined histologically.

Degeneration of the cells of the ganglion spirale similar to the changes in man were found. On the whole, in the central nervous system the changes in the ganglion cells were feeble. They were seen best in the case of lead; less with mercury and least with silver. The effects on the ganglion spirale were not in direct relationship to the dosage, and there appeared to be considerable variation.

Similar results with lead were reported by Missionjnik,[20] working with guinea-pigs. The degeneration occurred mainly in the ganglion spirale and spread toward Corti's organ, which, however, was not affected.

PATHOLOGY

Acoustic Tumors.—Gardner and Frazier [21] reported an interesting case of deafness due to bilateral acoustic tumors in which there was a history of familial deafness for five generations.

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18. Albrecht, W.: Zentralbl. f. Ohrenh. **33**:91, 1930.
19. Preobrajansky, A. P.: Zentralbl. f. Ohrenh. **33**:169, 1930.
20. Missionjnik: Zentralbl. f. Ohrenh. **33**:170, 1930.
21. Gardner, W. J., and Frazier, C. H.: Ann. Otol., Rhin. & Laryng. **39**:974, 1930.

A survey of the family history showed bilateral deafness in thirty-eight members with blindness in fifteen. Four of the deaf and blind members were examined before death, and were found to have choked disk and optic atrophy. The seven living members showed clinical signs of acoustic tumors; in four children born of affected parents the vestibular responses were absent, but there was no impairment of hearing, which shows that such tumors begin in the vestibular nerve.

Histologic examination of the specimen showed nerve fibers running through the tumor; it was evidently a true neurofibroma.

Schlitter [22] described an unusual case of acoustic fibroma accidently discovered in a patient with normal hearing. The patient, who was 47 years of age, was in the hospital because of an aortic aneurysm. The hearing was tested eight days before death. The ear-drums were normal, and the patient could hear a whisper at a distance of over 6 meters on both sides. He had had no noises in the ear or balancing disturbances.

Microscopic examination of the right ear showed normal perilymph and endolymph spaces and middle ear. The end-organs showed slight postmortem changes. The nerve fibers in the lamina and the ganglion cells were well stained. In the ramus cochlearis, a small, round tumor visible to the naked eye was found in the internal auditory meatus. On section it was seen that only a few fibers of the nerve passed around the tumor; the rest seemed to be interrupted. The proximal end of the cochlear nerves and the whole of the vestibular nerve were normal. Under high power magnification it was seen that the tumor had two components. When stained with van Gieson's stain, one component was seen to be composed of red fibers and the other of yellow fibrillary material that was very poor in cells and blood vessels. The other temporal bone was normal.

SYPHILIS

Wasowski [23] stated that there is otitis interna in 96 per cent of all cases of acquired syphilis. At the commencement, disturbances of the vestibule are more common than those of the cochlea. The caloric reaction is diminished more than the rotatory. This incongruity disappears in the later stages, and the cochlea is then more frequently affected. The commonest disturbances in acquired syphilis are a shortening of bone conduction, especially for the A^1 tuning fork. This occurs in 63 per cent of the cases. The perception of whisper is bilaterally lowered in 60 per cent. Hennebert's symptom was not seen in 120 cases of acquired syphilis, but it was present in 20 per cent of the congenital cases.

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22. Schlitter, E.: Ztschr. f. Ohrenh. **25**:105, 1930.
23. Wasowski: Zentralbl. f. Ohrenh. **33**:149, 1930.

Rebattu [24] is convinced that most cases of Ménière's syndrome are due to syphilis, congenital or acquired. In four of six of his cases antisyphilitic treatment was given, and the symptoms disappeared. He attributed the symptoms to endarteritis and spasm. He advised antisyphilitic treatment in all cases.

Marschak [25] wrote concerning malaria therapy in metasyphilitic acoustic lesions. He studied fifty cases of tabes and paralytica dementia and found nerve deafness in 38 per cent, and a lowered upper tone limit alone in 10 per cent, while forty-four showed shortened bone conduction without other symptoms.

Only twenty-five of these patients could be examined after malaria treatment. The period of observation varied from four to twelve months. Six patients with nerve deafness became almost normal, two of them showing striking improvement; one patient with nerve deafness did not show any change and two were worse; three patients showed a lowered upper tone limit, which after treatment returned to normal, while one patient's condition was unchanged, except that hearing for speech was decreased. In three of sixteen patients with shortened bone conduction but good hearing, nerve deafness occurred later; in one, the condition became worse, in four it was unchanged, and in five, better, while only one patient became normal.

For the malaria large doses of quinine had to be given, and this may account for some of the poor results. However, the author stated that as yet too little is known about these conditions to warrant conclusions.

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24. Rebattu: Zentralbl. f. Ohrenh. **33**:149, 1930.
25. Marschak, A.: Zentralbl. f. Ohrenh. **33**:45, 1930.

Abstracts from Current Literature

Ear

Brain Abscess as the Otologist's Problem. O. Jason Dixon, J. A. M. A. **96**:481 (Feb. 14) 1931.

Early diagnosis is an important factor in the management of abscess of the brain. More than 50 per cent of abscesses of the brain are otogenous, three fourths of these occurring as a complication of chronic mastoiditis. A large proportion of cases do not show positive neurologic signs, especially in the earlier stages, and must be diagnosed largely on the history and general symptoms, the most constant of which is uncontrollable headache. Lethargy, a slow respiratory rate, subnormal temperature, vertigo, vomiting, photophobia and slow cerebration are usual. Observations of the spinal fluid are variable and may be determined by an associated meningitis. The author expresses the belief that the fatalistic attitude of otologists and neurologists is unjustified in view of the number of cases in which recovery has resulted from surgical treatment. Recovery occurred in six of this series of twenty-five cases. Illustrative cases are reported in detail.

Jenkins, Indianapolis.

Occupational Nystagmus in Train Dispatchers. C. P. McCord, J. A. M. A. **96**:1131 (April 4) 1931.

The author reports that among 121 train dispatchers examined in widely separated sections of the country from seventeen railroads, occupational nystagmus has been detected in 81, or 87 per cent. In addition, in two cities, among thirty persons examined, 22, or 70 per cent, presented this condition.

The nystagmus found was essentially horizontal, with marked variation in the rate of motion, and with some variation in the rates for the two eyes.

The nystagmus of train dispatchers appears to be unassociated with aural conditions, although occupational deafness was noted in 56.2 per cent, and was more commonly present in the left ear, on account of the wearing of the hearing mechanism on that ear. It is believed that the noises common to the dispatching of trains are responsible for occupational deafness.

The nystagmus encountered among train dispatchers is accepted as of occupational origin and is attributed to the continued motion of the large paper train sheet beneath the eyes and the movement of the head and eyes over the sheet, both of which are necessary in the continual recording of data concerning the movement of trains.

It is maintained that the high frequency of the use of the eyes in connection with work on the train sheet leads to overworking of the ocular mechanism, resulting in a nervous syndrome characterized by nystagmus, blepharospasm, some visual impairment and ocular discomfort.

The occupational nystagmus of train dispatchers is less severe than the average nystagmus of miners, and no case has been encountered that in itself could be accepted as the cause of total disability.

W. Zentmayer.

Note on Sea-Sickness. Martin Flack, Brit. M. J. **1**:176 (Jan. 31) 1931.

One hundred and sixty-two cases of sea-sickness were studied on board ship to ascertain the relationship between the maintenance of ocular poise, pulse rate and blood pressure. The author's conclusions are: 1. Sea-sickness is predominantly of vestibular origin and is caused by uneven movement. 2. In certain cases in which the labyrinths are unduly sensitive, vomiting may occur early, due to reflex

stimulation of the vagus motor fibers to the stomach. Such cases are of the type that also favors air-sickness. 3. In cases of sea-sickness in which the labyrinth cannot be deemed unduly sensitive, its stimulation early induces or aggravates a degree of imbalance of the ocular muscles, which, combined with the continued stimulation of the vestibular apparatus, serves to provoke further symptoms. 4. Generally speaking, subjects in whom imbalance of the muscles of the eye is not induced or aggravated do not suffer from sea-sickness, although a slow pulse rate and a lowered blood pressure may cause a feeling of "limpness."

FERGUSON, Niagara Falls, N. Y.

NATURE AND DEVELOPMENT OF OTOLITHS. B. BELONOSCHKIN, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **128**:208, 1931.

Following a review of the literature, Belonoschkin reports his own investigations on chicken embryos and on grown chickens. The results of his studies are summed up as follows: The development of the otoliths is a nonvital process and is entirely like the calculus formation in the animal organism. Otoliths are stone concrements. The only vital process in their development is the elimination of the colloidal secretion from the sensory epithelium. This secretion represents a gelatinous substance. In this substance the calcium salts accumulate, and then precipitate in the form of crystals. Accumulation is effected by adsorption and perhaps also by chemical combination. The endolymph is not capable of retaining the salts of the otoliths in aqueous solution for the following reasons: Its quantity is limited; its reaction is alkaline; it contains only a negligible amount of (protective) colloids (protein 0.01 per cent), and it is impossible on the basis of Donnan's equilibrum between blood and endolymph. Because the gelatin is a well differentiated substance and because it is present only in certain locations (maculae lagenae, sacculi et utriculi), it is preformed before the precipitation of the otoliths. Such formations can be observed on the sixth day of hatching. On the seventh day, the day of the precipitation of the otoliths, the sensory hairs can already be observed. This contradicts Herzog's and Nishio's assertion, who maintained that the hairs develop much later and have no relation to the macularium formation. The relations between the gelatinous substance of the macularium and the sensory epithelium are not merely apparent and "only intimate;" they are closely connected. This is proved not only by the entire process of development, but also by observations on grown animals. The crumbly and thready formations within the labyrinth (they are likewise present in the central canal of the spinal cord), have nothing to do either with the macularium or with the otoliths. Thus the development of the otoliths can readily be traced to the colloid-chemical and physicochemical processes.

EDITOR'S ABSTRACT.

OTITIS AND MASTOIDITIS IN NURSLINGS. G. ALEXANDER, Monatschr. f. Ohrenh. **65**:437 (April) 1931.

Alexander begins his article with a discussion of the peculiarities of otitis and mastoiditis in nurslings. He points out that there are anatomic, physiologic and clinical differences. He then discusses the diagnosis and treatment. In the conclusion, he stresses the following points: 1. In all nutritional disturbances of nurslings the ears should be examined regularly, whether or not symptoms are present. 2. Inflammatory hyperemia of the tympanic membrane can often be recognized on the fine red branches in a gray opaque field. 3. Lowering of the posterior upper wall of the auditory meatus indicates mastoiditis or antritis. 4. Edema above the mastoid process can be detected only by comparative palpation of both mastoids. 5. If the otorrhea has continued for four weeks without showing a tendency to heal (no slimy pus), the mastoidea should be opened irrespective of local signs. 6. In cases of bilateral suppurative otitis paracentesis should be performed immediately and simultaneously on both sides. In cases of bilateral mastoiditis, however, the most severely affected side should be opened first; the other side often heals

without operative intervention. The operative trauma caused by a bilateral mastoidotomy that is performed in one session is too severe for a nursling. 7. Owing to the difficulty of otoscopy in nurslings, the amount of latent otitis increases. Really latent are the tuberculous otitis and tuberculous mastoiditis which occur comparatively frequently in infants up to 8 months of age. 8. Under poor hygienic living conditions, the dangerous combination of nasopharyngeal otitis and dyspepsia increases in frequency and in severity. EDITOR'S ABSTRACT.

INFLAMMATION OF A MALFORMED MIDDLE EAR. I. SENDULSKI, Monatschr. f. Ohrenh. **65**:454 (April) 1931.

Sendulski reports a case of inflammation of a misformed middle ear, which he observed before, during and after operation. In analyzing the case, he points out that the concurrence of developmental disturbances in the middle and the external ear is not surprising, since they develop from the same branchial cleft and arch. The presence of a functioning labyrinth is likewise not surprising, since the anlage of the middle ear and that of the internal ear have no connection with each other. Opening of the mastoid process revealed conditions which, in consideration of the patient's age (8 years), clearly indicated an early cessation in the development, for the dimensions of the antrum and of the tympanic cavity were small and the auditory ossicles were absent. From this it may be assumed that the malformation began in the period of intra-uterine existence when the auditory ossicles, the chorda and the muscles of the tympanic cavity were not yet present, which is perhaps at the beginning of the fourth intra-uterine month. Histologic examination of a piece of bone, the free surface of which reached into the tympanic cavity, revealed a thick layer of connective tissue with longitudinal fibers but no epithelial covering. Furthermore, if the anamnesis is considered, according to which the child suffered from acute attacks of earache from the first year of life, it is plausible to assume a relationship between the absence of the epithelial layer and the presence of fibrous scar tissue, on the one hand, and the continuous inflammatory condition of the ear, on the other hand. In regard to the manifestations of the disease, it is stated that the exacerbation of the inflammatory conditions involved mainly the nasopharynx and the eustachian tube (coryza and crackling sounds in the ears). The pains were in the middle ear, and from there they were projected to the mastoid process and to the external ear. The inflammation in the middle ear and in the eustachian tube increased the pressure and finally led to vertigo. The severe symptoms necessitated surgical intervention. The removal of the entire mastoid process facilitated the approach to the more deeply lying structures; it also allowed only a thin layer of tissue to close the middle ear to the outside, which was desirable because there was a possibility of a relapse of the inflammation and, consequently, perhaps also another operation. A thin layer of tissue was introduced between the outer covering and the cochlea with the hope that it would facilitate the perception of sound. The further course of the case and the perception of sound after the operation justified the surgical procedure. The attacks of pain disappeared, and the hearing was better than before the operation. EDITOR'S ABSTRACT.

PRIMARY TUBERCULOSIS OF MIDDLE EAR. F. ALTMANN, Monatschr. f. Ohrenh. **65**:460 (April) 1931.

Altmann describes the clinical history and the results of postmortem histologic examination in a case of primary tuberculosis of the middle ear. In a nursling, born of a tuberculous mother, swelling of the cervical lymph nodes set in when the infant was 3 months old. At this time the Pirquet reaction was negative. Three weeks later the symptoms of bilateral acute otitis became manifest, and two weeks after that a tuberculid of the cheek was noted. At that time the Pirquet reaction was positive. Subsequently, other signs of a miliary tuberculous dissemination developed. The infant died three months after the beginning of the

disease. Necropsy revealed a generalized miliary tuberculosis with tubercles of various sizes and in different stages of caseation. A primary complex could not be found in the lungs or in the regional lymph nodes. The pharyngeal organs and the intestinal tract were free from tuberculosis. The lymph nodes surrounding the ears and particularly the cervical and lateral retropharyngeal lymph nodes were enlarged and caseated. Both middle ears, especially the right, revealed tuberculous changes. The author considers the process in the right ear the primary focus of the disease, and he discusses various theories of pathogenesis. In the literature he found only a few reports of cases of primary tuberculosis of the middle ear. However, a review of these cases showed that the disease generally develops in infants less than 1 year of age; as a rule, between the third and seventh months. The clinical manifestations are so characteristic that one may speak of a syndrome: swelling of the lymph nodes in the region of the ear, secretion from the middle ear and sometimes facial paralysis and a positive reaction to tuberculin.

EDITOR'S ABSTRACT.

FORMERLY UNKNOWN TACTILE REFLEX OF AURICLE. K. BERNFELD, Monatschr. f. Ohrenh. **65**:473 (April) 1931.

Bernfeld reports the case of a man, aged 68, who had a chronic suppuration of the middle ear, and for two months a malignant tumor (sarcoma) of the outer wall of the auditory meatus. The tumor yielded to roentgen radiation. During palpation of the auricle, the author noted a peculiar slow contraction of the diseased auricle. Careful search for the cause of this manifestation revealed that the reflex developed by touching a certain site, namely, the region between the tragus and the condyloid process of the mandible. The auricular reflex took the following course: There were slight twitchings around the auricular orifice, on the tragus as well as on the antitragus, but they did not cause a contraction of the opening. Then there was a spasm above the helix, followed by a slight movement of the auricle forward and upward. The reflex disappeared in the same manner as it developed. It could be repeated two or three times. The reflex could not be produced in the healthy ear. Analysis of the contractions that developed during the course of the reflex showed that the following muscles were mainly involved: tragicus, antitragicus, auricularis superior, auricularis anterior and helicis major. It is pointed out that the tactile stimulation was not sufficiently strong, that a voluntary movement could have taken place; that the stimulation did not cause pain, and that the patient did not become conscious of the reflex. The author thinks that the reflex is the result of stimulation of a branch of the trigeminus nerve, namely, the auriculotemporal nerve. This nerve is connected with the facial nerve, and it is probable that this anastomosis is significant for the development of the reflex. Because the reflex is not present under normal conditions, its presence indicates pathologic changes in the ear. The patient did not show other signs of an increased nervous sensitivity. Two months later, metastases of the lymph nodes and a facial paralysis had developed. At that time the auricular reflex was absent. From this the author concludes that the tactile auricular reflex was perhaps an indication of the progressive involvement of the facial nerve by the tumor. When the conduction of the nerve was interrupted, the reflex ceased.

EDITOR'S ABSTRACT.

Larynx

LUNG IMMOBILIZATION IN THE TREATMENT OF PULMONARY TUBERCULOSIS AND ITS INFLUENCE ON THE LARYNX. J. P. DWORETZKY, Ann. Otol. Rhin. & Laryng. **39**:1111 (Dec.) 1930.

The basic principle in immobilization of the lungs in the treatment for pulmonary tuberculosis consists in the application of mechanical and physiologic rest through compression of the diseased lung. The procedure most commonly employed

is artificial pneumothorax, which consists of inflating the pleural space of the affected or more affected lung with air, thus compressing it for the purpose of securing necessary rest. This form of treatment may be beneficially employed in about from 10 to 15 per cent of all cases of pulmonary tuberculosis, and it is especially indicated in those cases in which the disease is active and progressive, in which the lesion is confined to one lung and in which the hygienic-dietetic treatment has been given a fair trial and failed to bring about the desired result. Another procedure frequently employed is phrenicotomy or phrenic evulsion, which consists of either severing or evulsing the phrenic nerve on the affected or more affected side through a small incision above the clavicle. The purpose of this procedure is: (1) to relax the diaphragm, thus aiding mechanical fixation of the lung, and (2) to cause partial compression of the lung through the elevation of the diaphragm, which usually occurs as a result of this operation. This procedure may be employed in those cases in which artificial pneumothorax cannot be induced, and may be used either as the sole treatment or as adjunctive treatment to other methods. The third commonly used measure is extrapleural thoracoplasty. This is usually employed in the type of case in which artificial pneumothorax is indicated, but in which the latter cannot be induced on account of extensive adhesions.

In a paper presented five years ago the author compiled two tables, one of which revealed 1,592 cases of pulmonary tuberculosis treated with artificial pneumothorax by various physicians, and tuberculous laryngitis developed in only 4 of these cases. The other table listed 32 cases of laryngopulmonary tuberculosis treated by artificial pneumothorax in 26 of which the condition was definitely improved, in 4 it remained stationary and in 2 the patient died. The 4 stationary cases were reported as not showing a satisfactory collapse.

The author has now compiled a table summarizing the statistics gathered during the past five years, showing the part that artificial pneumothorax plays in the prevention of tuberculous laryngitis. Tuberculosis of the larynx developed in only 12 of 5,382 patients treated in this manner, while in 56 patients with laryngopulmonary tuberculosis treated by immobilization of the lungs the laryngeal lesion was arrested or cured in 26, improved in 19, stationary in 5 and unimproved in 6. These results may be explained on the ground that tuberculous laryngitis is an infection of the surface which is always secondary to pulmonary tuberculosis or to tuberculosis elsewhere in the body and which occurs only in active cases, usually in those in which the sputum shows a positive reaction but never after an arrest has been definitely attained. Consequently, in order to prevent laryngeal tuberculosis, it is necessary to bring about an arrest of the active pulmonary lesion. From this it is concluded that a satisfactory collapse of the affected lung not only will prevent the development of tuberculous laryngitis, but will also exert a beneficial influence on an already existing laryngeal lesion.

SNAPP, Grand Rapids, Mich.

Nose

THE IMPORTANCE OF FOOD SENSITIZATION IN ALLERGIC RHINITIS. GEORGE PINESS and HYMAN MILLER, J. Allergy **2**:73 (Jan.) 1931.

The authors believe that food sensitization plays an important part in allergic rhinitis, because (1) allergic rhinitis is frequently associated with other allergic conditions commonly caused by food sensitization, (2) it is frequently perennial in its manifestations and (3) it is frequently associated with positive reactions to foods in addition to positive reactions to pollens, in many instances with positive reactions to food alone.

Of 1,971 persons who had symptoms characteristic of allergic rhinitis, 484, or 24 per cent, had no other allergic manifestations. Of 912 patients treated for pollen sensitization, 461, or 55 per cent, did not complain of perennial symptoms. Of 1,612 patients who reacted to pollen, 868, or 53 per cent, reacted to pollen alone.

HOYER, Cincinnati.

OPERATIVE TREATMENT OF CHRONIC SINUSITIS MAXILLARIS. C. E. BENJAMINS and E. HUIZINGA, Monatschr. f. Ohrenh. **65**:316 (March); 389 (April) 1931.

Benjamins and Huizinga first describe the technic of an endonasal operation for maxillary sinusitis, which is generally employed at the clinic in Groningen. The results of this method, although satisfactory, are not as good as those obtained in the endonasal operation on the frontal sinus, which they described (*Monatschr. f. Ohrenh.* **64**:288, 1930). In order to make a correct evaluation of the various surgical methods employed in the treatment for maxillary sinusitis, the authors made after-examinations on more than 250 patients. They found that the radical operation according to Caldwell-Luc results in cure in over 80 per cent of the cases, whereas the endonasal operations effect cure in only 60 per cent of the cases. Nevertheless, the latter procedure is preferable in many cases because the intervention is simpler, a factor to be considered in older persons and in patients with subacute inflammation. This operation can easily be combined with endonasal interventions on other sinuses, and it is a part of the Caldwell-Luc operation in case this radical procedure should later become necessary. Most cases of dental empyema may likewise be treated in this manner. Radical operation is necessary in the cases in which polypoid changes exist in the mucous membrane of the maxillary sinus. The authors' observations corroborate those of Fiol, who detected that relapse or retarded healing is often due to an involvement of the anterior ethmoid cells, which is preserved in the Caldwell-Luc operation. Intranasal evacuation of the anterior ethmoid effected cure in these cases. The authors further give a survey of the disorders that may develop after the operation. Special attention was given to the disturbances of the lacrimal canal and of the teeth. If the anatomy of the lacrimal canal is considered, it appears that injuries of this structure would develop much more frequently as a result of the operation than is actually the case. An investigation was also undertaken to determine how desensibilization of a part of the teeth develops as the result of radical operation. In the majority of cases this disturbance in sensibility disappears and has no detrimental influence on the teeth. In many patients who undergo an endonasal operation there is a temporary loss of sensitivity of the incisor teeth. It generally develops in persons in whom the anterior portion of the lateral nasal wall (alveolar nerves) has been cocainized.

EDITOR'S ABSTRACT.

RHINOGENIC ENDOCRANIAL COMPLICATIONS. M. HALLE, Monatschr. f. Ohrenh. **65**:425 (April) 1931.

Halle makes a rejoinder to Brühl's criticism of one of his statements that appeared in *Folia oto-laryngologie* (**17**:340, 1928-1929). Brühl states in the *Monatschr. f. Ohrenh.* (**64**:1061, 1930) that: "This case proves that Halle's statement about the harmlessness of resection of the septum in acute suppurations of the frontal sinus is not correct." Halle takes exception to this statement, because it implies that he recommended resection of the septum as a rule in acute suppurations of the frontal or the accessory sinuses. This, however, was not his intention, for on the preceding page he recommended conservative treatment as the method of choice and advised against instrumental intervention. Only for cases in which all conservative methods had failed and in which the symptoms were so severe that an intervention became absolutely necessary did he recommend the intranasal opening of the frontal sinus. He maintains that in these especially unfavorable cases submucous resection is the best and the least dangerous method.

EDITOR'S ABSTRACT.

Miscellaneous

THE BESREDKA THEORY OF IMMUNITY AND ITS POSSIBLE APPLICATION IN OTOLARYNGOLOGY. FRANK J. NOVAK, JR., Ann. Otol. Rhin. & Laryng. **39**:1033 (Dec.) 1930.

The experience of laryngologists with the various vaccines in the treatment for infections of the upper respiratory tract has been unsatisfactory. At the Pasteur

Institute under Besredka a new conception of immunity has been worked out, and has been given an extensive trial in Europe, both in the laboratory and in the clinic. It has been learned that the vaccination of large animals produces solid immunity in only a small percentage, and that in the small laboratory animals, particularly the guinea-pig, it is impossible to produce immunity. In studying anthrax, Besredka found that a guinea-pig in which the skin was desensitized by the application of a wet compress of an anthrax filtrate to the roughly shaven skin of the belly could receive a dose of live, virulent anthrax bacilli with total impunity. In other words, by immunizing the skin of a guinea-pig, the whole animal becomes solidly immune to anthrax. Injections of either vaccine or filtrate made into the blood, subcutaneously or intramuscularly, or its administration by mouth, fails to produce immunity to anthrax in the guinea-pig; the intradermal injection of a dose of anthrax filtrate, however, confers on the animal a solid immunity. In rabbits immunized by this method, the administration of a dose of virulent organisms, three thousand times the minimum lethal dose, failed to kill the animal.

This method received a rigid test in Syria in 1923, where the French cavalry was suffering an alarming loss of horses from anthrax. On using intradermal vaccination of the filtrates, the average mortality among the animals was reduced about twenty times. It was also used successfully in a widespread epidemic of bacillary dysentery. As regards its use in staphylococcal and streptococcal infections, Besredka stated that when a heated filtrate of a culture of these organisms is injected into the skin of an animal or man, it produces immunity that is specific against these two organisms. He refers to a large amount of experimental and clinical work in support of this statement.

The filtrate is prepared by passing through a filter, the medium in which the organisms have been grown, usually broth or broth serum, and thus filtering out all living organisms. If the filtrate is reinoculated, the bacteria will grow only sparingly. After the second filtration, a further effort to inoculate the medium fails, the organisms remaining viable but not growing. This second filtrate contains two substances. One is toxic and thermolabile, while the other is nontoxic and thermostabile. The filtrate is now heated to 100 C., which destroys the first or toxic thermolabile substance, which Besredka calls virus. The remaining, thermostabile substance, he calls antivirus. The filtrate is now ready for use either as a wet dressing over an abrasion of the skin or for intradermal injection.

SNAPP, Grand Rapids, Mich.

CHRONIC DIPHTHERIA ORIGINATING IN AND LIMITED TO THE TRACHEA AND BRONCHI. A. E. BULSON and E. L. BULSON, Ann. Otol. Rhin. & Laryng. **39**:1039 (Dec.) 1930.

Chronic diphtheria originating in the trachea and limited to that region throughout its course is an exceedingly rare condition. Such a case is reported by the authors who, after a careful search of the literature, find no identical condition described over a period of the past fifteen years. The patient, a housewife, aged 67, was observed carefully for fifteen months; at no time was there a membrane above the vocal cords, and diphtheria bacilli could not be procured from smears or cultures taken from the tissues above the larynx. With the laryngoscopic mirror some of the membrane could be seen immediately beneath the cords. Fragments of this membrane were coughed up from time to time, and it was from this that the diagnosis was made, as diphtheria bacilli were found in every piece examined. The patient was practically free from symptoms, except for an occasional cough when small pieces of the membrane were coughed up without difficulty. She had had influenza ten years previously and her general health had been poor since then, but she was never confined to bed. General physical examination gave essentially negative results.

Two doses of antitoxin, consisting of 40,000 units each, were administered without results. Extensive autogenous vaccine treatment was instituted, without

improvement, except that slightly larger pieces of membrane were coughed out. Injections of toxin-antitoxin were given, which also proved ineffective. At the time of the report the patient continued in fairly good general health, without symptoms except that she coughed up a small amount of membrane two or three times a month. A bronchoscopic examination was never made, as the patient objected to the procedure, but the authors feel that this method offers by far the best chance of relieving the condition.

SNAPP, Grand Rapids, Mich.

INVOLVEMENT OF SKULL IN OSTEITIS FIBROSA AND IN OSTEITIS DEFORMANS. W. MEYER, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **128**:169, 1931.

Meyer begins his article with a discussion of the similarities and the differences between osteitis fibrosa (Recklinghausen's disease) and osteitis deformans (Paget's disease). He points out that some authorities consider the two as identical because in both diseases there are fibrous changes of the bones. Others, while admitting a pathologico-anatomic identity of both diseases, show clinical differences. The author formulates his opinion as follows: Osteitis fibrosa occurs primarily in young persons and leads to the formation of brown tumors and cysts. Its localized form affects primarily the long tubular bones. The sites of the generalized form, when cited in the order of their frequency, are as follows: femur, tibia, humerus, the base of the skull, maxillary bones, pelvis, scapula and the vault of the cranium. Osteitis deformans is a disease that becomes manifest mainly in older persons, and in which formation of cysts is generally absent. In contradistinction to the atrophic processes of osteitis fibrosa, there are in osteitis deformans primarily hypertrophic processes. The sites of predilection for osteitis deformans are first the tibia and then the skull. Isolated disease of the cranium is equally rare in both diseases. Hyperostosis of the superior maxilla, which Bockenheimer considered as a form of Paget's disease, is no longer considered as such, because the histologic aspects of this condition resemble that of osteitis deformans only in rare cases. Paget's disease of the petrosa is of significance for the otologist, because in its clinical aspects it resembles otosclerosis. Osteitis deformans of the ethmoid bone is likewise rare. In the literature the author found only four cases. It cannot be definitely decided to what extent the rarity of recognition of Paget's disease of the ethmoid bone is due, owing to the fact that in extensive changes in other bones, pathologic processes in the ethmoid bone are easily overlooked, especially since cases of general osteitis deformans only rarely come under the observation of the rhinologist. At any rate one is justified to assume that in general osteitis deformans the localization in the ethmoid bone is not frequent, and the isolated disease of the ethmoid bone is extremely rare. In the second part of the article the author describes the clinical history of a woman in whom osteitis deformans was confined to the left frontal and ethmoid bones. He considers this likewise extremely rare. Because of inhibition of nasal respiration, the hyperplastic middle concha of the left side was removed. Later the ethmoid and frontal bones of the left side were subjected to roentgen treatment. After examinations six weeks and three months later, the patient had no complaints. In the conclusion the author states that, as a rule, radical interventions should be avoided in such conditions. In the reported case the removal of the nasal concha was merely a symptomatic measure because of the inhibition of nasal breathing. In regard to the efficacy of roentgen treatment nothing definite is known as yet, and overdosage may be harmful.

EDITOR'S ABSTRACT.

PANTOCAINE (DERIVATIVE OF PROCAINE HYDROCHLORIDE) A SATISFACTORY SUBSTITUTE FOR COCAINE. H. G. RUNGE and H. SCHMIDT, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **128**:232, 1931.

Runge and Schmidt first point out why it is desirable that a satisfactory substitute is found for cocaine. They then direct attention to pantocaine, which is

a derivative of procaine hydrochloride. A comparison of the structural formulas of procaine hydrochloride and of pantocaine reveals that in pantocaine one diethyl group of procaine hydrochloride has been replaced by a dimethyl group with the addition of the butyl radical. On the basis of investigations and following one and one-half years of clinical experiences, the authors reach the following conclusions: For injections as well as for surface anesthesias, pantocaine is a satisfactory substitute for procaine hydrochloride and for cocaine. Its 1 per cent solution is as effective as a 10 per cent solution of cocaine. In regard to its toxicity, it is stated that its 1 per cent solution has the toxicity of a 2.5 per cent solution of cocaine, but since a much lower concentration is required in the case of pantocaine its relative toxicity is lower than that of cocaine. Pantocaine can be used in all forms of local anesthesia, and the prolonged duration of anesthesia produced with it is of particular value in infiltration and in conduction anesthesia. Comparative tests of the efficacy of cocaine and its different substitutes revealed the superiority of the 2 per cent pantocaine solution, but since in 95 per cent of the cases the 1 per cent solution of pantocaine produces complete anesthesia of the mucous membrane, the 2 per cent solution is required only in exceptional cases. Hemolysis experiments revealed that pantocaine does not injure the tissues. Pantocaine is soluble in water, and in contradistinction to cocaine, it is stable and sterilizable, and it is ten times cheaper than cocaine. Addition of epinephrine is possible and advisable.

EDITOR'S ABSTRACT.

CAUSAL THERAPY OF HAY-FEVER BY DESENSITIZATION. E. WESSELY and V. KOERBEL, Monatschr. f. Ohrenh. **65**:412 (April) 1931.

Following a review of the history of desensitization treatment, Wessely and Koerbel report the cases of eighteen patients who received this treatment. Retrospective consideration of the cases convinced the authors that the asthmatic symptoms were most effectively counteracted. Two patients who during the season for hay-fever also had weeping eczema remained free from it following treatment. In some cases, the symptoms of the nose and eyes became manifest temporarily as the result of severe exposure, for many patients deliberately exposed themselves in order to test the effect of the treatment. Others, however, remained free from these attacks in spite of exposure. The authors further discuss the value and technic of the cutaneous tests and the extent to which they are influenced by the desensitization treatment. They also report that in patients in whom a number of extracts gave positive reactions, they gave treatment only for the three substances that caused the strongest reactions. However, it was found that the treatment was either a partial or a complete failure. From this they conclude that desensitization treatment must be given against all allergic substances that give a positive reaction. They think that although the specific desensitization cannot entirely counteract the hypersusceptibility, it can reduce it considerably so that the person remains practically healthy. They hope that further observations will reveal and help to overcome the shortcomings that the treatment may as yet have. In regard to reactions during the treatment, they state that general reactions develop only if extremely large doses are given. In most cases the reactions can be counteracted by the administration of epinephrine or ephedrine.

EDITOR'S ABSTRACT.

OTOGENOUS ABSCESSES OF THE BRAIN. J. SPIRA, Monatschr. f. Ohrenh. **65**:446 (April) 1931.

Spira states that during the last year he treated three patients with abscesses of the brain, whose cases are noteworthy from the diagnostic as well as from the therapeutic point of view. The first case concerned a patient who had suffered from a bilateral suppuration of the middle ear since childhood; he was under-

going treatment for disorders of the accessory nasal sinuses, when suddenly severe intracranial symptoms developed: fever, headaches, vomiting and retardation of the pulse. Since neither the pathologic processes in the ear nor those of the nasal sinuses showed exacerbation, an otogenous cerebral process was suggested. Examination revealed changes of the dura, but exploratory puncture of the frontal lobe gave a negative result at first. Two days later, however, a large abscess was discovered, and after several days symptoms of encephalitis developed, which became more severe in spite of the fact that the secretion of pus decreased. Because of this the usual treatment for abscesses was discontinued, and Leidler's continuous tamponade was resorted to. During the course of this treatment, the symptoms became so severe that the tampon had to be removed. The abscess healed, but a prolapse of the brain made an approach to the suppurating tympanic cavity difficult. The method of treatment for abscesses of the brain usually employed by the author is as follows: First a wide incision of the abscess (cross-section) is made. Excision of a large portion of the dura is followed by tamponade by means of a gauze-covered drain. The bandage is changed daily, and stagnating pus is removed from the wound. As soon as the secretion of the pus lessens, which is often the case after several days, the drainage of the cavity is discontinued and a superficial tampon is introduced in order to retain a wide opening. The necrosing portions of the brain surrounding the wound are repeatedly excised. The author points out that the evaluation of a therapeutic method for cerebral abscesses is difficult because the outcome is influenced by so many factors, such as the size and shape of the abscess, the type and virulence of the bacteria, the power of resistance of the patient and the stage at which the abscess is subjected to treatment, that the method of treatment is not always the decisive factor. However, he points out that the Leidler-Feuchtinger method, which many investigators consider the best, failed in this case. Among other unusual aspects, the author mentions the profuse otorrhea, which set in four months after the opening of the abscess. Although the discharge of cerebrospinal fluid from the ear following such interventions is not an absolute rarity, it is unusual for the discharge to occur after such a long interval; ordinarily, it is noted immediately after the intervention. The author describes and discusses the other two cases of abscess of the brain. In the conclusion he points out that in cases of acute otitis in which there are signs of a complicating abscess of the brain mere puncture is not sufficient, but a deep incision should be made. By such a radical procedure, he hopes to prevent incorrect diagnoses and a harmful postponement of a necessary intervention.

EDITOR'S ABSTRACT.

Society Transactions

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLARYNGOLOGY

Feb. 18, 1931

H. P. Schenck, M.D., *Reporter*

Ralph Butler, M.D., *Chairman*

Dr. G. Hudson Makuen's Treatment of Stammerers. Mrs. Mary S. Steel (by invitation).

It is difficult to epitomize Dr. Makuen's work, but the many reprints available are each complete articles with technical detail. It is to be regretted that more attention has not been given to nomenclature, especially in the direction of simplification. Dyslalia must be differentiated from pseudolalia. Preventive measures are directed toward three stages of stammering: prodromal, acute and chronic. The time to cure stammering is before it begins. Speech and mental development occur simultaneously. Normal speech is largely automatic. The child does not know how hesitation happens or how to prevent it. The difficulty suddenly occurs with excitement, increased heart action and general tension. Repetition takes place. This is the prodromal stage and it is here that the turning point occurs. The child should not be scolded, ridiculed or admonished against stuttering. No references should be made to relatives or ancestors who had imperfect speech. Mishandling at this stage results in the appearance of acute manifestations. If the child is tided over the prodromal period, progression is halted and the remedy is easy.

To save the child from the second or third stage, one should not permit him to hear rapid speech; action should be slow and deliberate, and standards of speech should be raised for the other members of the family. The child must be encouraged in play to repeat speech. There should be plenty of sleep and no exciting influences. Fear of speech leads to the second or acute stage. The treatment in the acute period is similar to that in the first stage, and consists in keeping the child from school and training it in the mechanism of speech. Reference should not be made to defects of speech. Training is best done in a special school, away from the brothers and sisters. In the third stage the defect has fully developed with psychologic variations and fear is predominant. Fear is a characteristic of the chronic stammerer. It is useless to tell him that his fears are groundless. The one thing uppermost in his mind is that he cannot speak as others do, that he is out of tune and out of control. He is self-conscious and although he desires to speak, he knows he cannot, and the disability becomes more marked.

The predisposing causes are inherited or congenital. The tendency to stammer may be transmitted from the parents. Stammerers appear to be unable to arouse certain auditory images. The exciting causes may be due to peripheral obstruction or to a rapid, excitable environment. In the chronic stage one must go back to the beginning. A new type of speech as well as a new superstructure must be developed. The articulatory mechanism is only for steering; no speech is obtained without proper cerebration. The patient is trained to use only the movable parts of the respiratory mechanism. Before speaking, he should never take a full breath but merely the normal quantity as in the military position. Much practice is necessary. Stammering is generally due to faulty or delayed phonation. Training of the voice is essential. The physical voice produced is not the same for speaking as for singing. Training in speech is the more valuable. The

voice must be made to take first place in speech, producing phonation rather than articulation. Control is acquired by volitional effort. Many stammerers are profoundly neurotic, but the neurosis is more resultant than causative. The treatment is therefore approached through the physical rather than the psychic. Many cannot be approached through any other avenue than speech. Hypnotism has been used. To be effective, treatment must be psychophysical. No two stammerers are alike, and the treatment is different in each case.

DISCUSSION

DR. GEORGE M. COATES: Fifteen or twenty years ago Dr. Makuen impressed on us the importance of studies on defects of speech. Several times a year he read papers and presented patients, but his work was a continuous struggle against the inertia of members of the medical profession, and he succeeded in interesting otolaryngologists only to a limited extent. Success in this field requires much time. One cannot practice otolaryngology and also treat patients for defects of speech, for the latter work is a specialty in itself. Stammering has been divided into three stages, and the proper cure is accomplished before it has begun. Many in the medical profession and patient's family will regard the condition as temporary, and firmly believe that the child can be "laughed out of it." Mockery of the child by playmates makes matters much worse. The important point is the training of the family and the child's companions rather than the child.

DR. JAMES A. BABBITT: I think that most of us have felt helpless in dealing with stammering. In my class at Yale a certain boy stammered and almost wallowed in his efforts to speak. Twenty-five years later, at a class reunion, he was introduced by the president as the speaker of the evening and made a brilliant oratorical impression. A relative of mine by marriage had a harelip, and later stammering and infantile paralysis. He went to Cornell where he attended a school that taught him a curious manner of speech. Within a year he spoke extremely well.

DR. B. ALEXANDER RANDALL: I ought to be competent to speak on this subject as I occupied the room next to Dr. Makuen's for several years. It struck me as curious that in some of these cases, hesitation is greatest when conversational efforts are made, whereas the person may make a fairly good speech. Some of my associates were more fluent in addressing an audience than in general conversation. There are decided differences between those who are victims of this infirmity, and there are many different methods of correction. Some can chant, but have difficulty in conversation.

MRS. M. S. STEEL: I want to thank Dr. Coates for his great interest in this work. Ethical work is being done in schools by teachers, and some of it is excellent. This work, however, should be done before the child goes to school, and the physician should correct it before school age. Much unethical work still goes on. The man whom Dr. Babbitt mentioned did a lot of hard work in those twenty-five years. I have seen many persons with cleft palate but never one that stuttered. In order to correct their speech one must teach them to make sounds that they have been unable to make with a cleft palate. The Martin School in Ithaca may be the one to which Dr. Babbitt referred. Unethical schools frequently make use of rhythm. The singer thinks of a tune rather than words. I knew a physician who studied Dr. Makuen's methods because he had hesitation in speech. He thought that he was helped most by impersonation (a Southern drawl, Scotch accent, etc.), during which he could speak without difficulty. He kept this up until he could speak English well. In reference to Dr. Randall's remarks it should be recalled that Charles Kingsley could preach brilliantly, but stammered in conversation. Many stammer but sing well or make good speeches. It is necessary to phonate, articulate and coordinate with the mind correctly. Each person's voice should be as low as is consistent with free vibration. In the case that Dr. Babbitt mentioned a falsely low tone engaged the attention of the patient and aided him in speech.

EXPERIMENTAL PROOF THAT INTENSITY OF THE VOICE CANNOT BE MAINTAINED AT A CERTAIN LEVEL. DR. DOUGLAS MACFARLAN (by invitation).

The criticism that the voice test of hearing is unreliable is justly based on the fact that the intensity of the voice cannot be maintained at a chosen level. In the experimental work of making a record of constant intensity for use with the phonograph-audiometer, a list of monosyllables were chosen from the vocabulary of the preschool child, i. e., the simplest and most familiar words of the language. This was done with the purpose of reducing to a minimum the factors of intelligence, memory and education. The words were also selected to cover the variety of vowels and consonants to some degree, due consideration being given to words acoustically difficult of interpretation. The records were made at the Victor recording studio by Mr. Erdman who has been occupied for many years with recording and acoustics of the voice. Great care was taken to maintain what appeared to be a constant level of intensity. Three records were made, the same series of words being used in each. It was found that the intensity of the words varied considerably. The words were spoken with different force. In using this type of record in testing the hearing and interpretation of the human voice, it is interesting to note that when, by means of rheostats, the intensities are dropped to a point near the threshold of hearing, it is the consonants and not the vowels that are misinterpreted. In this study the words are merely considered in the crudest light of their total intensity. Analysis of pitch and the study of the sequence of the various fundamentals of the vowels and consonants would supplement the aforementioned study. The records showed that the interpretability is not due solely to the loudness of the words.

DISCUSSION

DR. PHILIP STOUT: Are we to understand that in a person with a normal voice the intensity of the same tone varies from 20 to 45?

DR. MACFARLAN: What Dr. Stout brings up is interesting because it seems so remarkable. The man who made these records is well trained and knows the acoustic value of the sounds. On hearing him, one would think the intensities the same. Acoustically the force of different words is different. Some are explosives. One of the key considerations is that one hears sounds largely according to their loudness.

LESIONS OF THE PTERYGOMAXILLARY FOSSA (REPORT OF THREE CASES). DR. ROBERT J. HUNTER.

It was shown that the pharyngomaxillary fossa may be infected by way of the various important structures that are contained in it or surround it. Owing to the position of the fossa, abscesses in this region do not tend to point on the surface. An incision should be made early when there are abscesses in this area.

Three cases were reported; in one the infection arose from the ear, in another from a peritonsillar abscess and in the third from the lymphatic glands. In the first case, a woman, aged 45, had been admitted to the hospital with a diagnosis of pneumonia, after an illness of ten days during which a peritonsillar abscess had ruptured spontaneously. The glands of the neck later became swollen and the patient became dyspneic and expectorated blood-tinged sputum. Several hemorrhages from the mouth followed, one of 600 cc. occurring after admission. Swelling of the right arm developed, with red streaks following the lymphatic vessels, and the right leg showed general redness and swelling. Direct laryngoscopy revealed long strings of blood clot in the larynx and trachea. The dyspnea disappeared following the removal of the clots. A large black mass in the left tonsillar region pushed the palate to the right. The left tonsil was entirely eroded, and the removal of clots revealed a large cavity. The common carotid was therefore tied. No abnormality of the jugular vein was noted in the exposed area. There was no pus about the great vessels. The patient had no more hemorrhage; the wound

remained clean, the throat improved and there was no more dyspnea. As fluctuation developed in the left thigh and arm, surgical drainage was done and pus obtained; later the entire subcutaneous tissues of the arm and leg seemed to break down. The temperature ran a low course throughout and was never septic. *Streptococcus hemolyticus, Staphylococcus hemolyticus* and *Micrococcus catarrhalis* were cultured from the abscess of the leg. Cultures of the throat were negative. One month and two days after admission to the hospital the patient died. Permission for autopsy was refused.

In the second case, a colored woman, aged 45, had had a discharge from the right ear for sixteen years. Menstruation had ceased following a gynecologic operation eight years before, but since that time she had bled from the ear every month. Five days before admission to the hospital she awoke with a pain on the right side of the throat and noticed an ulcer in the tonsillar region. Swelling on the right side of the face anterior to the ear followed, and became so extreme that chewing was impossible. On examination, a large, nonfluctuating, tender swelling was found in the parotid region, with swelling of the parotid orifice, but no pus was expressed on pressure. The external auditory canal was full of pus and was nearly occluded by a swelling half-way toward the drum, but no pain, tenderness or swelling was noted over the mastoid. The anterior pillar of the tonsil was red; the tonsils were not involved. The posterior pillar and adjacent side of the uvula were slightly edematous. Palpation revealed fulness in the right lateral wall of the pharynx. The day after admission the patient suddenly became stuporous, and a preoperative determination of blood sugar revealed 402 mg., with a blood urea content of 40. Operation was postponed and the patient was transferred to the metabolic service. The following day, the mental condition was more clear, but the swelling over the parotid became more marked and a symmetrical bilateral submental swelling appeared. The medical service was of the opinion that the blood sugar and blood urea nitrogen were not sufficiently high to explain the comatose condition, and the neurosurgical consultant examined the patient. Finding the pupils contracted and fixed to light, and reflexes lost in all extremities, with flaccidity of the left arm and leg, he made a diagnosis of left hemiparesis, probably due to an extradural abscess in the middle fossa, rupturing through the foramen ovale into the neck. The best avenue of attack appeared to be through a radical operation on the mastoid, and this was done under local anesthesia. The mastoid process was not markedly involved, but the antrum and middle ear were filled with cholesteatoma, polyps and pus. The dura was normal. The middle ear was thoroughly cleansed, and necrotic bone in the floor of the tympanum was curetted. A great amount of foul pus welled up from the neck. The patient died on the operating table. Examination of the spinal fluid post mortem gave negative results. Autopsy revealed a large abscess in the pharyngomaxillary fossa. A probe was passed through the carotid artery and jugular vein with ease. There was no evidence of thrombosis or extradural abscess. The meninges were normal. The right half of the brain was markedly anemic.

In the third case, a boy, aged 14 years, had a sore throat several years after tonsillectomy. This subsided, but later the patient noted a severe pain back of the left side of the jaw, inability to open the mouth freely and pain in the ear. Several days later the drum became mildly suffused and light pink, and the jaws could be opened only with great difficulty. There was edema at the base of the tonsillar fossa. Back of the posterior pillar in the left lateral wall of the pharynx was a sausage-shaped swelling, with some fluctuation, leading to a diagnosis of abscess in the lateral wall of the pharynx. An incision into this mass did not reveal pus. The next day the abscess opened at a higher plane back of the palate. Recovery was uninterrupted. This was apparently a case of abscess of the pharyngomaxillary fossa due to the breaking down of an infected lymphatic gland.

DISCUSSION

DR. TEMPLE FAY: I was much interested in the patient whom I was called to see. Dr. Petty felt that the profound coma could not be due to diabetes *per se*.

The patient had a clearcut lesion involving the fifth, sixth and seventh nerves on the right and therefore outside the dura. The lesion was a left-sided paresis. The Babinski sign was bilateral. The condition was ruled out of the neurosurgical field because of the cerebral edema. We felt that the lesion was not only extradural but also extracranial. These cases present an interesting symptom-complex. Some of them do not show pus, and one does not always find a mass of pus above. The nonproductive type may involve only the fifth and sixth nerves. The plucking of a hair in the trigeminal zone produces excruciating pain. One also notes a prompt anisocoria, which is diagnostic. Pain in the carotid artery may be reflex even from as low as the gallbladder. The important point in Dr. Hunter's paper is: "What caused the stupor?" In 70 per cent of cases the longitudinal sinus turns to the right, and the left lateral sinus drains only the veins of Galen. The predominance of the large sinus is to the right. Desperate cases are frequently associated with a pathologic process on the right side. As shown at autopsy, this patient had a foramen hernia. Bilateral cerebral edema was present. Occlusion on the right side is more important than occlusion on the left. I believe that this woman had obstruction interfering with drainage and producing cerebral edema. I do not know whether death was due to the anesthetic or to obstruction. The mechanism of the right jugular vein is the interesting point to follow here, and this case interestingly illustrates a right-sided lesion.

DR. O. V. BATSON: The pterygomaxillary or pharyngomaxillary fossa is usually not clearly understood. Two well defined fossae or collections of areolar tissue exist in these areas. I believe that anything in front of the vessels belongs to the pterygomaxillary or pharyngomaxillary fossa. The tonsil is at the upper pole of the line of blood vessels running up the neck. If anterior, the location of pointing is beneath the mandible; if posterior, beneath the mediastinum. It is always possible to make the opening through the mouth if the infection has not progressed too far. Any blood vessel that crosses bone has its thin side toward the bone. Any condition that causes erosion of the temporal bone comes down where the blood vessel is thinnest. In many skulls bone is missing in the apex of the petrous portion of the temporal bone. Drainage above the palate was probably traveling in the prevertebral fascia.

DR. B. ALEXANDER RANDALL: In my study of the temporal bone (1,000 or more preparations) I found a right-sided preponderance in the size of the lateral sinus in 60 per cent.

DR. DAVID HUSIK: In this case it was decided that intracranial intervention and metabolic management were not vital, so that the otolaryngologist was forced to assume responsibility. The external canal was filled with polyps. It was decided to perform the operation on the mastoid under general anesthesia. I have thought that it might have been better to tie off the jugular vein before I proceeded.

DR. KARL M. HOUSER: We frequently tie the internal jugular vein, and in several reported cases both jugular veins were tied. We have not feared cerebral edema in the cases in which the vein was tied on one side alone.

DR. TEMPLE FAY: Given a block in the venous system and given time, compensation occurs. Compensatory circulation is established before operation, and for that reason no damage is noted. If the vein is tied suddenly, pressure and edema occur. The cortical supply is often drained to the right, and the cortical supply is important for consciousness.

DR. O. V. BATSON: The French describe four types of torcula, and with arrows show the direction of the flow of blood. Books on osteology show this variation. What happens when one ligates the jugular veins? Skulls differ enormously. In acute jugular obstruction trouble will ensue unless there is sufficient extrajugular drainage. The posterior jugular vein described by the French, but not insisted on by the Germans, frequently drains the mastoid area.

DR. B. H. SHUSTER: Dr. Hunter's paper reviews the anatomy and physiology, and Dr. Batson's discussion has added a great deal. In necks that are normal

anatomically one finds the structures as described in the textbooks, but when swelling occurs the anatomic differentiation is frequently lost. Dr. Dandy described the center for consciousness as situated in the left lobe. We need Dr. Batson with us to correlate these facts.

DR. ROBERT HUNTER: This brain was not tremendously edematous; the condition was revealed microscopically rather than macroscopically. On the side of the lesion the brain was anemic; the opposite side had congested vessels. On the affected side the cells showed poor staining, with a tendency to the so-called "ischemic cell disease," and there was a tremendous glial increase. There was considerable edema on both sides, not more on one side than on the other. Blocking of the carotid may have occurred, as the brain was anemic on that side; the onset was sudden, and tremendous edema of the brain was not noted.

March 18, 1931

POSTOPERATIVE TREATMENT BY RADIUM IN RADICAL MASTOIDECTOMY. DR. JOSEPH C. KEELER.

Enough work has been done to demonstrate that the use of radium in aural treatment is something more than a possibility, but more clinical evidence must be available to extend its usefulness and establish its actual worth in certain otologic lesions. I have presented fifty cases in which radium was employed as an adjuvant to postoperative care. In otology, the usefulness of radium is almost entirely outside the field of malignant disease, the field in which it is most commonly employed and with which it is most closely associated. In the cases presented radium was applied during the healing of wounds resulting from mastoidectomy, and in all cases radium was used only after surgical intervention. Radium should never be regarded as a substitute for proper surgical measures. Only after necrotic bone and damaged tissue have been removed can efficient work be performed by radium. The labor it performs is regenerative — not destructive. Its curative properties depend on its power to build up damaged cell structure.

Cooperation between the otologist and the roentgenologist is essential to the successful use of radium in otology. While the action of radium is lethal in large dosage, in moderate quantities it is stimulative. Occasionally one encounters conditions that are beyond the limits of even the most skilfully performed operation, in which life may be dependent on the preservation of a blood vessel threatened by advancing necrosis which the surgeon is powerless to stay, or paralysis may be imminent by reason of the disease encroaching on trunks of vital nerves. A circumscribed suppurative labyrinthitis, as a necrotic process, may erode through the petrous pyramid, exposing the internal carotid artery. A radical surgical procedure must be first in order, but what this cannot fully accomplish may be brought to a successful termination by the judicious use of radium. In cases in which discharge persists from the tympanum and the eustachian tube or dermatization is delayed because the formation of granulations is slow or wholly lacking, radium has proved of the greatest possible assistance.

As a routine, the containers of radium emanation were filtered with 1 cm. of wood and 1 mm. of lead, except when the container was a platinum needle (12.5 mg.) inserted directly into the cavity of the middle ear. In most of the cases reported the patients had previously undergone radical mastoidectomy, and a number had had several so-called "mastoid operations" before coming under observation. In a few cases radium had been used because surgical measures were contraindicated. In cases of circumscribed suppurative labyrinthitis, in which opening of the labyrinth may well usher in a generalized infection, with meningitis and death, or in which the surgeon is convinced that he will induce facial paralysis

if his work is extended further, the use of radium before further intervention should always be considered. It is always possible to operate later if radium proves ineffectual. In cases in which fibrous growths persisted in the region of the oval window, or in which there were polypoid formations following radical mastoidectomy in fistulous openings in and about the cochlea, two or three sessions, totaling from three to six hours, with applicators of 50 or 100 mg., proved adequate to remove the new growth and permit dermatization. In one patient, a large fibroma clogged the meatus, but it was removed rapidly after treatment with radium; in another, there was persistent return of the granulations in the region of the oval window, as well as persistence of the fistulas in the same location.

Cost is no longer an objection, since every large center either has a supply of radium available in the form of applicators containing the element, or maintains a radium emanation plant, by means of which the cost and flexibility of this therapeutic aid are regulated.

DISCUSSION

DR. JAMES A. BABBITT: Does the radium have a direct effect in stopping the latent discharge which follows radical operation?

DR. PHILIP STOUT: How many failures were there? What was the percentage of failures? Were any unfavorable effects noted in occasional cases in this series?

DR. JOSEPH C. KEELER: In some cases with persistent discharge excellent results followed one or two applications, and the area became dry. We did not obtain 100 per cent success, for this medium is merely an adjuvant. In the great majority of cases, it proves effectual.

THE USUAL COURSE AND RELATIONS OF THE NERVUS FACIALIS AND THE PRACTICALLY IMPORTANT VARIATIONS. DR. O. V. BATSON.

The portion of the facial nerve within the temporal bone is alone considered in this discussion. It is divided into five topographic portions: (1) meatal, (2) geniculate, (3) tympanolabyrinthine, (4) arcuate and (5) mastoid. The arcuate portion curves over the oval window, becoming the more or less vertical mastoid portion. The meatal portion is of interest (chiefly to the neuro-otologist) because of its relation to the infratentorial arachnoid space. The geniculate portion is exposed to the dura of the middle cranial fossa in childhood and sometimes throughout life. The canal of the tympanolabyrinthine portion, lying in the wall common to the internal and middle ear, is perforated by small nerve foramina and is the site of dehiscences. The arcuate portion, with the lateral semicircular canal lies in a dense mass of bone which forms one boundary of the aditus ad antrum. The other two walls of this triangular constriction are the posterosuperior wall of the external canal and the tegmen tympani.

The mastoid portion begins at the level of the eminentia pyramidalis, which houses the stapedius muscle. Between the cavity in the eminentia and the facial canal there is a foramen for the stapedial nerve and sometimes osseus deficiencies. These openings and that for the chorda tympani, lower down, are potential routes of communication between the cavum tympani and the mastoid portion of the nerve.

A landmark, undescribed, for the mastoid portion of the facial canal is the tympanomastoid suture. During the course of an operation this may be located with a probe. The facial nerve lies medial to this suture at a depth which depends on the lateral thickness of the mastoid process.

The distance between the suprameatal spine (Henle) and the sigmoid sinus determines the ease with which the antrum tympanicum can be approached. When this distance is short, more space is obtainable by removing the posterior meatal wall. The other wall, about the sigmoid sinus, must be avoided because of the sinus and because of the mastoid portion of the facial nerve.

DISCUSSION

DR. EDWARD B. GLEASON: Dr. Batson is the keenest observer I have ever known. He has given us a simple way of testing the depth of the mastoid process. The facial nerve passes through the internal auditory meatus anterior to the auditory nerve. At the bottom of the meatus the facial nerve enters the facial canal and follows its course throughout. At first the canal is directed horizontally outward, then bends abruptly backward, passes above the fenestra ovalis and turns downward, behind the pyramid, in the posterior wall of the tympanic cavity, to end at the stylomastoid foramen. There are other means of getting the position of the stylomastoid foramen. If in a basal case one runs the probe along the digastric groove posteriorly, the facial nerve will be reached. The "ridge pole of the digastric fossa" always at its extremity is over the stylomastoid foramen. With these matters in mind there is no great difficulty in locating the stylomastoid foramen, and we know that the course is in a straight line from that point to the posterior border. Dehiscences are not uncommon, and persist in adult life. There is great thinness of bone over the horizontal portion of the nerve in many skulls. The facial nerve has always been a bugbear. What has been said tonight makes it a simple matter to outline the facial nerve and avoid it.

April 15, 1931

A MODIFIED ATTIC DRAINAGE IN CHRONIC SUPPURATIVE OTITIS MEDIA (PRELIMINARY REPORT). DR. JAMES A. BABBITT.

During the past three years, operation was performed in twenty-three cases of chronic suppurative otitis media, some of them bilateral (twenty-nine ears in all). A majority of the patients had cured, "dry" ears; all of them were improved. The hearing level had been raised, and the complications were confined to one case showing a rotary nystagmus and vertigo of three days' duration, which might have been due to the rather severe mastoid exenteration on the opposite side, performed at the same time by an associate.

In chronic diseases of the middle ear, the attic space becomes badly damaged. It is conceded that at least the antrum of the mastoid shares the involvement. The squamous cell areas, promontory, ossicles and tympanic membrane afford special opportunity for fibrous change. The whole area may be semiobliterated by thickening, sclerosis and adhesions, so that drainage downward from the iter ad antrum remains but a narrow tortuous channel, defying simple treatment. If this upper posterior quadrant could be converted into an open, rather rectangular drainage, even at further sacrifice of tympanic membrane, but preservation of the annulus, it seemed possible that the trouble might spontaneously cease; that even diseased ossicles freed from surrounding pressure might regenerate or cover in their surface sufficiently to become innocuous and even after this somewhat traumatic disturbance, carry audition value.

The age in the cases chosen ranged from 4 to 74 years, and the duration of discharge from six weeks to fifteen years, though the length of time seemed to bear little relation to success or speed in recovery. Three important preliminary conditions are important. The mastoid, except for its antrum, should be in a quiescent state. Contributing factors, such as adenoids, infection in the posterior ethmoids and active infection in the auricular canal or glands about the ear, should be eliminated. The patient should be promised only improvement, as a second or third procedure may be necessary.

The operation requires but a brief period under nitrous oxide and oxygen anesthesia and is followed by little pain; a repetition to control drainage is not contraindicated. In this procedure one works from the posterior inferior quadrant. If the perforation is anterior, lateral or inaccessibly high, make a fresh incision and continue up under the tense and full flaccid membrane in the posterior superior quadrant, reaming this space out with a blunt right-angled probe. After cleaning this space thoroughly, cut off portions of the overhanging membrane to secure

free drainage. If necessary, push aside but avoid removal of any portions of the malleus or incus. If the former protrudes down into the lower enlarged opening, later healing will render this stationary and perhaps somewhat effective in the transmission of sound. The final step is to insert angular curets reaching to the iter ad antrum and curet away any blocking granulations. It seems possible that one may disturb the facial nerve as it passes down beneath the passage from attic to antrum, but this accident has not so far occurred, nor has any nerve irritation been noted.

The follow-up treatment has been more or less empiric. The patient has been kept in bed about three days. At the time of operation a strip of gauze packing, dipped in mercurochrome-220 soluble or metaphen solution, is inserted. This is allowed to remain the first night. The following day the ear is irrigated with physiologic solution of sodium chloride by means of a bulb syringe, the canal dried with cotton and a few drops of 2 per cent phenol in glycerin instilled into the canal. This is irrigated at first every three hours and, after the first thirty-six hours, three times daily. In four or five days the discharge lessens. Active irrigation is stopped, the ear is wiped with a cotton swab and touched with strong metaphen solution. It is possible that all this irrigation is superfluous, but the conditions are not similar to those in early acute catarrhal or acute suppurative involvement of this area. The single important point in the early convalescent period is to maintain a sure drainage.

DISCUSSION

DR. OSCAR V. BATSON: Dr. Babbitt performed his operation on several cadavers in which the tegmen tympani had been removed revealing the malleus and incus. I was looking down from above while Dr. Babbitt was carrying out his technic below. As he worked he described the location of the instrument and invariably the instrument was in the location that he described. Limiting the opening automatically prevents interference with these ossicles. The question might arise as to injury to the stapes and the oval window. Judging by the density of the attachments of the footplate, portions of the stapes would give way before the footplate was dislodged from the oval window.

DR. GEORGE M. COATES: Dr. Babbitt has well said that chronic suppurative diseases of the ear are the bane of otolaryngologists. Any method that will clear up some of these is valuable. We are between the extremes of radicalism and conservatism. When there is little mastoid infection we should employ intratympanic methods as far as possible. Even ossiculectomy may be contraindicated because of deterioration of hearing. Dr. Babbitt's plan sounds simple and feasible. We all know that if one can get free drainage from the cavity, half of the battle is won. I see no reason why if the discharge is limited, the diminution of deterioration of hearing should not follow. By removing granulations and breaking up adhesions we should get improvement rather than diminution.

DR. EDWARD B. GLEASON: It is a well known fact that many chronic otorrheas due to attic suppuration clear up if cleanliness is observed. The incus is frequently separated from the stapes and the stapes lies free in its niche. Removal of a cholesteatoma frequently results in an abrupt cure. Even the removal of a polyp may result in cure. In using an instrument devised to remove polyps from the antrum, I once removed the stapes. About the same time Dr. Stout had the same unfortunate experience. There was a discharge of perilymph for several days with some vertigo, and then the condition cleared up. As far as necrosis is concerned, the superficial necrosis will take care of itself if cleanliness is observed. In most of these cases sclerosis of the mastoid process has occurred with a diminution in the size of the antrum. Often a fistula extends from the antrum into the necrosed mastoid and is the source of the discharge. Such a method would prove ineffectual in these cases. Stacke's operation is occasionally successful but not as uniformly so as the radical operation on the mastoid. In Philadelphia all of us are getting results from the modified radical operation in which the contents of the tympanum are preserved.

DR. J. C. DONNELLY: At the Children's Hospital, I saw a child with a history of three years' suppuration. We were anxious to perform an operation on the mastoid. Later I saw the child after Dr. Babbitt had used this technic and the results were excellent. At the University I saw a number of patients similarly treated and the results were uniformly satisfactory. I am certain that this method secures drainage.

DR. S. D. WEEDER: I am interested in this operation and believe that it will do much in the successful handling of these cases. I should like to know what type of operation Dr. Babbitt would advise in a case of pure attic suppuration with a punched-out perforation? Should one make an incision from below or from above?

DR. F. G. PRESSMAN: I saw a third of Dr. Babbitt's cases. In the case in which nystagmus occurred following operation I had uncovered the lateral semicircular canal. Next day nystagmus occurred. The postauricular wound was opened and the area cleaned up. If the nystagmus had been due to interference on the opposite side, a destructive labyrinthitis would have occurred and this would not have cleared up. We are forced to the conclusion that the nystagmus was due to traumatic labyrinthitis occurring on the side on which the operation on the mastoid was performed. The success of this operation is not only due to the drainage. Early in the course of convalescence we can see with the otoscope islands of epithelium growing over a fibrous tissue base. We not only secure drainage after the operation but induce epithelization. The ears do not drain after operation but remain dry. One case that Dr. Babbitt considers a failure was due to mucoid secretion that entered from the eustachian tube.

DR. JAMES A. BABBITT: Dr. Butler asked me why we did not remove the ossicles. Shock is obtained when they are removed. This other procedure takes only from five to ten minutes. By leaving the ossicles, we may get an attachment to the drum and make some audition possible. As to the question of leaving infection behind — we assume that mastoid infection has become quiescent — by opening up the antrum, healing occurs from above downward and we do not assume blockage from below. One case showed attic suppuration and I deliberately made an opening below and cleared up the condition. So in these cases Dr. Weeder mentions, I make a low incision.

MALIGNANT CONDITIONS OF THE LARYNGOPHARYNX. DR. HENRY B. ORTON (by invitation).

Drawbacks to operations on the laryngopharynx may be classified into three groups: (1) the uncertainty of cure, which is the most important; (2) the danger after as well as during the operation, and (3) the mutilation and disability that may result from an operation otherwise perfectly successful.

Intrinsic cancer is being well attacked by both laryngofissure and laryngectomy, but something can be done for patients who are suffering from so-called extrinsic cancer of the larynx. Better terms are epilaryngeal cancer, a growth originating on the epiglottis, aryepiglottic folds, pyriform sinus or lateral wall of the pharynx, and hypopharyngeal cancer, occurring in the lower part of the pharynx.

Lateral transthyroid pharyngotomy impressed me as being an ideal procedure by which to attack malignant conditions of the pharynx. I have had occasion to perform this operation on nine patients, with an operative mortality of two, or 22.3 per cent, both of the patients dying of septic pneumonia within thirty-six hours. Three patients had a recurrence in the glands six months, and one patient nine months, following operation; one lived for one and a half years, and two are living at this writing, one patient now for over one year and the other for eight months.

Microscopically, we are concerned only with the squamous cell epithelioma. Mr. Trotter's classification shows the hypopharyngeal group, which involves the cricoid region and the posterior pharyngeal wall, and which is practically limited to women. The group known as the epilaryngeal, which involves the arytenoids, aryepiglottic folds, epiglottis, pyriform sinus and possibly the base of the tongue, is almost entirely limited to men. In the order named, a growth involving the epiglottis, aryepiglottic folds, lateral wall of the pharynx and postcricoid and

pyriform sinus gives the best prognosis. If the growth has had its origin from the lateral wall of the larynx, it soon involves the pyriform sinus and thyroid cartilage, and nothing short of complete laryngectomy, with a partial or entire cervical esophagus, will be of any use. This group is the most discouraging one for any operative procedure; yet if the condition is seen early enough, a few additional years of life may result from the operation.

After a preliminary tracheotomy, the incision for ordinary transthyroid pharyngotomy would be along the anterior border of the sternomastoid muscle, reflecting anteriorly and posteriorly the muscles of the larynx. But as most of these patients, by the time they are examined, have enlarged glands of the neck from either infection or lymphatic extension, it becomes necessary to perform a resection, and the former incision is inadequate. An additional incision is then made more or less at right angles to the original one, running from the angle of the jaw downward, forward and upward to the symphysis.

These flaps and the platysma are turned back; the superficial fascia, the submaxillary gland and the deep fascia are likewise removed upward and backward as far as the spinal accessory nerve and posterior triangle. This step exposes the deep vessels of the neck and the muscles surrounding the larynx. All the vessels that come off anteriorly from the great vessels are ligated and cut. The internal jugular is ligated and resected. The external carotid may or may not be ligated. The sternomastoid may or may not be removed, depending on the glandular involvement.

The next step is to suture the sternomastoid to the prevertebral fascia; this covers the great vessels and thus protects them from infection when the pharynx is opened. The area is drained by a counteropening posteriorly.

The following muscles are then reflected from the hyoid bone and thyroid cartilage: the hypoglossal, thyrohyoid, sternohyoid, sternothyroid, stylopharyngeus and the inferior and middle constrictors of the pharynx. One is then ready to remove, by means of heavy scissors, the exposed portions of the hyoid bone and the greater portion of the thyroid cartilage. This permits palpation of the growth through the pharyngeal aponeurosis and mucous membrane, and enables one to decide where to make the opening into the pharynx so as to be well around the malignant area; or if the growth is too large to remove, one may back out, so to speak, and not proceed further. The pharynx is then opened. Before operation, one has a fair idea of how much tissue it will be necessary to remove, and the flap is made sufficiently large to fill up the defect. A feeding tube is inserted into the esophagus. Later, a plastic operation is performed to close the neck.

DISCUSSION

DR. FIELDING O. LEWIS: I have greatly enjoyed Dr. Orton's presentation of this important subject. Dr. Orton has made a plea for early diagnosis. Dr. Jackson has frequently pointed out that many cases of chronic hoarseness, if investigated, would reveal early stages of these conditions, and many lives would be saved. According to our records, the larynx was often not visualized for from ten to twelve months after the onset of the growth. When the condition is limited to the vocal cords, cure is obtained in from 70 to 80 per cent of cases in which laryngofissure is a suitable procedure. In extrinsic forms of cancer, the patient may have few symptoms until the disease is far advanced. These cases are seen far too late and are usually hopeless. Of 150 cases at the Philadelphia General Hospital, all of which were extrinsic, less than 1 per cent were suitable for treatment. X-rays and radium were mentioned by Dr. Orton. We have had no good results with radium and x-rays alone, but have frequently had good results with operation, radium, x-rays and electrocoagulation. When cases of extrinsic cancer were formerly seen the patient was given palliative treatment and death was awaited. Now we are saving a few of these patients. Dr. Orton showed some of these "hopeless" cases in which the patients were still enjoying life after some of these extensive operations.

DR. GABRIEL TUCKER: I appreciate the cases that Dr. Orton has shown. We would all do well to study them.

Directory of Otolaryngologic Societies *

NATIONAL

American Medical Association, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Gabriel Tucker, Bronchoscopic Clinic, Hospital of the University of Pennsylvania, Philadelphia.
Secretary: Dr. John J. Shea, 1018 Madison Ave., Memphis, Tenn.
Place: New Orleans. Time: 1932.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. F. Barnhill, Miami Beach, Fla.
President-Elect: S. Hanford McKee, 1528 Crescent St., Montreal, Canada.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: French Lick, Ind. Time: Sept. 14-19, 1931.

American Bronchoscopic Society

President: Dr. Louis H. Clerf, 128 S. 10th St., Philadelphia.
Secretary: Dr. Richmond McKinney, 899 Madison Ave., Memphis, Tenn.

American Laryngological Association

President: Dr. Francis R. Packard, 304 S. 19th St., Philadelphia.
Secretary: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Place: Atlantic City, N. J. Time: June 15-17, 1931.

American Laryngological, Rhinological and Otological Society

President: Dr. Max A. Goldstein, 3858 Westminster Pl., St. Louis.
Secretary: Dr. R. L. Loughran, 33 E. 63d St., New York.

American Otological Society

President: Dr. David H. Walker, 101 Bay State Rd., Boston.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

SECTIONAL

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. G. G. Marshall, 122 West St., Rutland, Vt.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

New England Otological and Laryngological Society

President: Dr. Harry P. Cahill, 520 Commonwealth Ave., Boston.
Secretary-Treasurer: Dr. Lyman G. Richards, 319 Longwood Ave., Boston.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Chester H. Bowers, 1136 W. 6th St., Los Angeles.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Albert E. Hillis, 1115 Pacific Ave., Tacoma, Wash.
Secretary-Treasurer: Dr. Francis A. Brugman, 806 Cobb Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

* Secretaries of societies are requested to furnished the information necessary to make this list complete and to keep it up to date.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. Claude T. Uren, City National Bank Bldg., Omaha.
Secretary-Treasurer: Dr. Frederick H. Roost, 420 Trimble Bldg., Sioux City, Iowa.
Place: Fontanelle Hotel, Omaha. Time: November, 1931.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. Fletcher D. Woodward, Box 162, University, Va.
Secretary: Dr. W. D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: New Orleans. Time: November, 1931.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. Wilfrid Haughey, 65 W. Michigan Ave., Battle Creek.
Secretary: Dr. R. H. Fraser, Battle Creek Sanitarium, Battle Creek.
Time: Third Thursday of alternate months.

STATE

COLORADO OTO-LARYNGOLOGICAL SOCIETY

President: Dr. C. E. Cooper, 227, 16th St., Denver.
Secretary: Dr. Rex L. Murphy, Metropolitan Bldg., Denver.
Place: Assembly Room of Metropolitan Bldg. Time: First Saturday of each month from October to May.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Dorland Smith, 836 Myrtle Ave., Bridgeport.
Secretary-Treasurer: Dr. Walter L. Hogan, 750 Main St., Hartford.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. William L. McDougall, 50 Whitehall St., S. W., Atlanta.
Secretary-Treasurer: Dr. William O. Martin, Jr., 412 Medical Arts Bldg., Atlanta.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. John W. Carmack, 23 E. Ohio St., Indianapolis.
Secretary: Dr. J. Kent Leasure, 23 E. Ohio St., Indianapolis.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Gordon F. Harkness, 215 Main St., Davenport.
Secretary-Treasurer: Dr. W. F. Boiler, 105 East Iowa Ave., Iowa City.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. John C. Brown, 350 St. Peter St., St. Paul.
Secretary-Treasurer: Dr. Hendrie W. Grant, Lowry Bldg., St. Paul.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. L. H. Huber, Livingston.
Secretary: Dr. A. W. Morse, Phoenix Bldg., Butte.
Time: Semi-annually.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. H. B. Beeson, 232 W. De Mers Ave., Grand Forks.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. H. M. Hendershott, 193, 11th St., Portland.
Secretary: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. Raymond F. Hacking, 105 Waterman St., Providence.
Secretary: Dr. Herman A. Winkler, 224 Thayer St., Providence.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

UTAH OPHTHALMOLOGICAL SOCIETY

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. W. Leroy Smith, Erza Thompson Bldg., Salt Lake City.

VIRGINIA SOCIETY OF OTOLARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Fletcher D. Woodward, Box 162, University.
Secretary-Treasurer: Dr. Henry Grant Preston, Harrisonburg.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. S. S. Hall, Fairmont.
Secretary: Dr. G. A. Smith, Montgomery.

LOCAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

Chairman: Dr. J. Wallace Hurff, 86 Washington St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

ATLANTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. John R. Childs, 45 Edgewood Ave., Atlanta.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.
Place: Academy of Medicine, 38 Prescott St., N. E. Time: 8 p. m., last Thursday of each month.

BALTIMORE CITY MEDICAL SOCIETY, SECTION ON OTOLOGY AND LARYNGOLOGY

Chairman: Dr. William R. McKenzie, 11 E. Chase St., Baltimore.
Secretary: Dr. James J. Chisolm, Medical Arts Bldg., Baltimore.
Place: 1211 Cathedral St. Time: 8:30 p. m., last Friday of each month.

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. George J. Dennis, 25 E. Washnigton St., Chicago.
Secretary-Treasurer: Dr. Austin A. Hayden, 25 E. Washington St., Chicago.
Place: Medical and Dental Arts Bldg., 185 N. Wabash Ave. Time: 6 p. m., first Monday of each month from October to May.

CINCINNATI OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Edward D. King, 707 Race St., Cincinnati.
President-Elect: Dr. M. F. McCarthy, Union Central Bldg., Cincinnati.
Secretary-Treasurer: Dr. Samuel Seltz, Provident Bank Bldg., Cincinnati.
Place: University Club. Time: 6:45 p. m., second Tuesday of each month from October to May.

CLEVELAND ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. William V. Mullin, 9204 Euclid Ave., Cleveland.
Secretary: Dr. H. C. Rosenberger, 2064 E. 9th St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLARYNGOLOGY

Chairman: Dr. Ralph Butler, 2007 Chestnut St., Philadelphia.
Clerk: Dr. Karl M. Houser, 1826 Pine St., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., third Wednesday of each month from October to June.

COLUMBUS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

Chairman: Dr. A. M. Hauer, 327 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. Albert D. Frost, 681 E. Broad St., Columbus, Ohio.
Time: First Monday of each month.

DALLAS ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. M. Sellers, 717 Pacific Ave., Dallas, Texas.
Secretary: Dr. W. Mood Knowles, 717 Pacific Ave., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

DETROIT OTO-LARYNGOLOGICAL SOCIETY

President: Dr. Don A. Cohoe, 13535 Woodward Ave., Detroit.
Secretary-Treasurer: Dr. R. Lee Laird, 513 David Whitney Bldg., Detroit.
Place: Maccabees Bldg. Time: Third Wednesday evening of each month from October to May.

FORT WORTH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. J. Richardson, 606 Penn St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, 1304 Medical Arts Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

HOUSTON ACADEMY OF MEDICINE, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. Claude C. Cody, 1306 Walker Ave., Houston, Texas.
Secretary: Dr. J. M. Robinson, Eye, Ear, Nose and Throat Hospital, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

INDIANAPOLIS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. E. L. Lingeman, 241 N. Pennsylvania St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

KANSAS CITY SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. A. E. Eubank, Arygle Bldg., Kansas City, Mo.
Secretary: Dr. O. S. Gilliland, Professional Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

LONG BEACH EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Dean E. Godwin, Security Bldg., Long Beach, Calif.
Secretary-Treasurer: Dr. Ferris Arnold, Security Bldg., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

LOS ANGELES COUNTY MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Eugene R. Lewis, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Hospital, assembly room. Time: 8 p. m., first Monday of of each month, May to November, inclusive.

Medical Society of the County of Kings, Section on Otolaryngology

Chairman: Dr. John M. Auwerda, 878 President St., Brooklyn.
Secretary-Treasurer: Dr. Charles R. Weeth, 37 Remsen St., Brooklyn.
Place: Library Bldg., County Society, 1313 Bedford St., Brooklyn.
Time: 9 p. m., second Wednesday of January, March, May and November.

Medical Society of the District of Columbia, Section on Ophthalmology and Oto-Laryngology

Chairman: Dr. James A. Flynn, 1511 Rhode Island Ave., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St., N. W.: Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

The Milwaukee Oto-Ophthalmic Society

President: Edward R. Ryan, 425 E. Water St., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 120 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Hilliard Wood, 700 Church St., Nashville.
Secretary-Treasurer: H. C. Smith, Medical Arts Bldg., Nashville.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

New Orleans Ophthalmological and Otological Society

President: Dr. W. R. Buffington, 211 Camp St., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: January to June and October to January—third Thursday of each month.

New York Academy of Medicine, Section of Laryngology and Rhinology

Chairman: Dr. John M. Loré, 240 West End Ave., New York.
Secretary: Dr. Robert E. Buckley, 2 E. 103d St., New York.
Place: 103d St., and 5th Ave. Time: 8:30 p. m., fourth Wednesday of each month from October to May.

New York Academy of Medicine, Section of Otology

Chairman: Dr. Clarence H. Smith, 2 E. 54th St., New York.
Secretary: Dr. James Garfield Dwyer, 57 W. 57th St., New York.
Place: 103d St. and 5th Ave. Time: Second Friday of each month from October to May.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Arts Tea Room. Time: 5:15 and 7 p. m., third Wednesday of each month from October to May.

Philadelphia Laryngological Society

President: Dr. Arthur J. Wagers, 1429 Spruce St., Philadelphia.
Secretary: Dr. Herman B. Cohen, 1301 Spruce St., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., first Tuesday of each month from October to June.

Pittsburgh Otological Society

Chairman: Dr. James Homer McCready, 121 University Place, Pittsburgh.
Secretary-Treasurer: Dr. Roy C. Cooper, 510 S. Aiken Ave., Pittsburgh.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Emanuel U. Wallerstein, Professional Bldg., Richmond, Va.
Secretary: Dr. William R. Weisiger, Medical Arts Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. Clyde Heatly, 11 N. Goodman St., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 S. Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Association, 13 Prince St. Time: 8 p. m., third Monday of each month from October to May.

St. Louis Ear, Nose and Throat Club

Acting President: Senior member of the executive committee: Dr. George E. Hourn, 607 N. Grand Blvd., St. Louis.
Secretary: Dr. Arthur M. Alden, Frisco Bldg., St. Louis.
Place: University Club Bldg. Time: Third Wednesday in February, April, October and December.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. T. J. Walthall, 728 Main St., San Antonio, Texas.
Secretary-Treasurer: Dr. E. D. Dumas, 425 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Wilber F. Swett, 693 Sutter St., San Francisco.
Secretary: Dr. Robert Carson Martin, 384 Post St., San Francisco.
Place: Society's Building, 2180 Washington St., San Francisco. Time: Third Tuesday of every month except May, June, July and December.

Spokane Academy of Ophthalmology and Otolaryngology

President: Dr. Paul A. Remington, Old National Bank Bldg., Spokane, Wash.
Secretary: Dr. Louis A. Parsell, Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Paulsen Medical and Dental Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. Searle B. Marlow, State Tower Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubinstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.

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